EDITORIAL

WHO said the foundry business was not prosperous? An automobile-stage company has applied for permission to discontinue service between Newark and Centerville. It seems that the principal source of business for the stage company used to be carrying workers back and forth from the foundry at Newark. All this is changed. Not only have many of the foundry employees bought cars of their own but they also carry their fellow-workers, and this has cut the profit out of the stage business.

HARD times have struck the Krupp plant. The balance-sheet for 1919 shows a deficit of 36,000,000 marks. If we take the mark at its par value that sounds like a lot, and even at the present exchange rate of a cent or two, it is more than many of us could afford to lose, at least in one year. However, there must have been a pretty big surplus carried over from the days when the munition business was good in Germany, so we are not worrying about what may happen to the Krupp stockholders. In place of munitions, locomotives and other railroad rolling-stock, agricultural machinery, and moving-picture apparatus are being manufactured.

SEATTLE has shown that it is still an American city by electing Mr. H. M. Caldwell mayor over Mr. James Duncan, who was prominent in the general strike a year ago. Defeat was also the portion of most of the candidates for the council endorsed by the faction that was nicknamed the 'Who-Knows-Where' party, from the memorable phrase used in the general-strike proclamation. While many voters, both in Seattle and elsewhere, are dissatisfied with conditions as they are, they will require a lot of 'showing' before they will vote for men that are even suspected of a desire to make fundamental changes in our form of government. The 'Who-Knows-Where' kind of politics does not go in America.

THE United States Steel Corporation has been given a clean bill of health by the Federal Supreme Court. The decision, which comes nine years after the suit to dissolve the Corporation was brought by the Government, was by a four to three vote, two justices not voting because of disqualifications. The majority decision in the main appears to follow the distinction between 'good' and 'bad' trusts made by Roosevelt, and holds that mere size and even controlling position in an industry is not unlawful as long as the resulting power is not used to gain unfair advantage over competitors or in any other way against the public interest. This, the Court finds, the Corporation has refrained from doing, at least, since the suit was started in 1911. The Court, therefore, distinguishes between the conditions found in the present case and those in the Standard Oil and the American Tobacco cases, and denies the petition for an order dissolving the Steel Corporation.

CLAIMS against the Government presented by various commercial concerns that tried to help win the War and lost money in the attempt are numerous. One of the saddest cases we have seen is that of a Washington canning firm that tried to can dogfish using a formula furnished by the Bureau of Fisheries. Whether or not the public, which is known to be 'finicky' and conservative in its tastes, would buy this canned dogfish does not enter into the presentation of the claim. For the formula was no good. The contents of the cans fermented, producing an acid that combined with the tin, and the two together with the fish to produce a substance that was unpalatable to say the least. Even the Bureau admitted that the formula was faulty and recommended an appropriation to pay this and similar claims, but no such appropriation was made by the Congressional committee. Later in the War other and better formulas were developed, but the mischief had already been done. The 'dogfish claims' may yet become an issue in the coming campaign.

THE National woman's suffrage amendment has at this writing been ratified by thirty-five States and it seems reasonably certain that a thirty-sixth will be found in time to permit voting by women throughout the country at the November election. Such National action was sure to come in a few years, but, as in other countries, it has been hastened by the War. The political influence of women in this country has been greatly increased by another by-product of the War, although the effect may not be so directly apparent as that of the extension of the suffrage. As we all know, knitting sweaters and preparing other Red Cross supplies was not the only thing that the women of America did to help win the War. Among other things they did yeoman service in the canvassing for every 'drive'. This was better organized in some districts than in others, but almost every community had its organization of women that did anywhere from a large share up to practically all of this work. Never in the history of the world have women worked in organized efforts as they did during the War. Having learned to do this, it is only natural that they should continue. Right now, most of the pre-primary canvassing, in California at least, is being done by women, who learned how during the War. This condition is going to keep on right up to November 2. No gift of prophecy is required to see that this will be followed by a considerable amount of control of both party organizations by the women voters. Well, how do you like the idea?

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Some 'Pep' Left Yet

A man in Chicago, who runs a psychopathic laboratory, whatever that may be, and who has various letters before and after his name, is all broken up. He has just made the discovery that the women are running the country and that they are running it into the ground. In fact it is pretty near there now. Prohibition is one evidence of it. The Inter-Church Movement is another. Worst of all, he says, "American 'pep', which was the result of a masculine-dominated country, is almost a thing of the past." Only a few years ago certain individuals bewailed the fact that the pursuit of money and the luxurious living consequent upon its acquirement had deprived the Nation of its virility, but Hindenburg and his followers did not find it so. We are inclined to think the psychopathic man is also mistaken. Probably he has spent too much time in his laboratory. He had better get outside for a few weeks and see what people with 'pep' are still doing in America.

Classification of Industrial Accidents

An important aid in the 'Safety-First' movement has been the collection and classification of statistics regarding accidents, particularly industrial accidents. Unless accurate information is available regarding accidents, it is impossible either to inform the public regarding the magnitude of the problem or to plan intelligently for its solution. In the records prepared by both commissions and private corporations, industrial accidents are classified in many different ways, according to the part of the body affected, seriousness of injury, hour, day, and month of occurrence, department of factory, age and sex of injured, etc. We have yet to see, however, a report in which accidents are classified in detail according to jobs. We know, in general, what kinds of jobs are most dangerous in a given trade, but detailed statistics are lacking. Such statistics, combined with carefully prepared job specifications and physical examination of employees would assist in the prevention of accidents not only by safeguarding equipment but also by the selection of men physically best suited for a given job. Furthermore, in these days when the man has to be 'sold' the job, it would be of advantage for the employment manager to be able to say to a prospective employee, "Yes, it is supposed to be a dangerous job in most plants, but of the 30 men we had on that class of work last year, not one was more than slightly injured."

Progress in Aerial Navigation

Coming on top of recent practical achievements in the use of aeroplanes, the announcement that Mr. Peter Cooper Hewitt, capitalist, scientist, and inventor of the Cooper Hewitt lamp, has perfected a helicopter capable of rising vertically from the ground is of more than ordinary interest. Incidentally, it may point the way to the verification of the prediction made several years ago by Mr. Thomas A. Edison that the air-navigating machine of the future would not be the biplane, but rather a flying machine supported by one or more air-screws turning on vertical axes. The principal basis for Mr. Edison's contention was the fact that, as was abundantly demonstrated at the flying fields during the War, manipulation of a biplane calls for special skill and is something that cannot be learned by everyone. This, Mr. Edison held, would limit the popularity of flying. It is believed that the problem of flying with the Hewitt machine will not be nearly so intricate. There is another aspect to the question that is almost if not quite as important. The present types of aeroplane require large areas for successful landing, and considerations of cost require that these landing-fields be placed on the outskirts of cities. The helicopter, on the other hand, could land with safety almost anywhere. The 'busy business man', who finds the railroads too slow, might not feel like making a trip by aeroplane if it involved going several miles at either end of the journey in some other conveyance, whereas, if the distance were only a few blocks, the case would have a different aspect. The development of the Hewitt helicopter, which is admittedly still in the experimental stages, will be followed with interest.

Defeat of the Treaty

Petty partisan politics are responsible for the fact that nominally we are still at war with Germany and that the League of Nations must continue to try to function without this country. Out of 96 senators, 81 were in favor of ratification of the treaty, and we believe that the sentiment of the country as a whole is at least as strong, but the remaining 15 senators, 14 Republicans and 1 Democrat, were able by skilful jockeying, which approached chicanery, to defeat the will of the people. Yet the blame is not theirs alone. President Wilson and the Democratic senators who, favoring the treaty without reservations, defeated it when submitted with reservations, are almost equally guilty. It is foolish to talk as the President does about a "solemn referendum" at the coming election. In the first place, it won't and can't be done. The people of the country are divided between those who favor ratification without reservations, those who favor ratification with mild reservations, such as those suggested by Mr. Taft, those who favor ratification with the Lodge reservations or something similar, and those who are opposed to the treaty in any form. The last class are in a relatively small minority, but they have had their way so far. We believe that a large majority of the other three classes, in preference to the present situation, would favor almost any form of compromise ratification. But there will be no way in which they or anyone else can indicate their wishes directly at the coming election. Instead, injection of the Treaty issue into the campaign will simply distract attention from the important domestic issues that form the proper lines of cleavage of the voting public.

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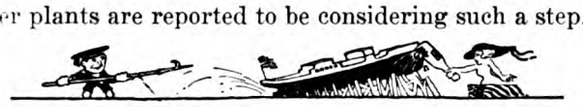
The Bay District Strike

No material change is to be noted in the metal trades strike on either side of the Bay. The principal employers in both shipyards and outside shops are continuing to increase their forces slowly but steadily. On the other hand, several concerns have surrendered to the unions, either openly or actually. The latter class of surrender usually takes the form of nominally operating an open shop, but refraining carefully from hiring non-union men, and acceding to the other conditions that characterized operations before the strike but were supposed to have been eliminated after the shops opened last November. The struggle takes on more and more the appearance of a contest of endurance. As it proceeds the lines are drawn tighter and tighter. At first concerns operating open shops had little difficulty in getting castings from union foundries. Now all this is changed and orders for large quantities of castings are going not only to Stockton and other near-by towns, but even as far as Los Angeles. Again, many small shops, not members of the California Metal Trades Association, that ran 'open' before the strike without having trouble with union authorities are now confronted with the alternative of signing with the unions or of having their union men ordered out. Several national and international union officials are in San Francisco at the present time, and are holding conferences with the local leaders. It is expected that overtures for conferences with the California Metal Trades Association will be made soon. Judging from its policy since the strike was originally called, it seems probable that the Association will refuse to enter such conferences. The Schaw-Batcher shipyard at South San Francisco is to be closed and the contracts that would have been completed there are to be finished at a Los Angeles yard. Several metal-trades concerns have recently moved all or a large part of their activities to places where labor conditions are more satisfactory and other plants are reported to be considering such a step.



Government Efficiency

At the close of more than twenty years of public service, seven of which have been spent at the head of one of the most important Federal departments, Mr. Franklin K. Lane, formerly Secretary of the Interior, made a statement regarding the inefficiency of governmental activities at Washington that should be read by every American citizen. Public officials he finds in general to be intelligent, honest, and devoted. The system under which they work he finds to be incorrigibly and grotesquesly inefficient. There is too much red tape, too much division of authority from responsibility, too many chances to 'pass the buck', and too little co-ordination and efficiency. As we have noted already, Mr. Lane has had abundant opportunity to observe these conditions. Insofar as he could, he labored to correct them. But, even in his own department, the inertia of the whole system was too strong for any one man to combat successfully. What Mr. Lane has to say regarding Federal affairs applies with greater or less force to State, county, and municipal affairs as well. In the old days, the slogan of almost every political campaign was 'Turn the Rascals Out!' There was graft then, and there is some now. But where graft has taken its thousands of the people's money, inefficiency has taken its tens of thousands. Now and then some energetic department-head such as Mr. Lane has tried to improve matters, only in the end to become convinced that little can be accomplished by any individual. These conditions are the fault of the whole people and can be corrected only by action of the whole people. The time is now ripe for such action. Before the War, when customs and excise taxes formed the principal sources of revenue, we used to delude ourselves into believing that the foreigner and the saloon-keeper paid the tax. Now we have prohibition, while the government expenses have risen so that the customs revenue has become unimportant by comparison. Directly or indirectly we are paying large taxes, Federal, State, county, and municipal, and the thought that a large part of this money is wasted is getting on the nerves of most of us.

The Industrial Conference Report

The first industrial conference called together by President Wilson broke up because of disagreements in less than three weeks after it assembled. The personnel of the second conference, while representative of the entire country, was selected in such a way as to make serious disagreement less probable. In particular the lines of cleavage between capital, labor, and the public were not observed. At any rate, this second conference, after sessions lasting over three months, has submitted a report that we believe marks an important step toward the attainment of better industrial relations.

The report sets forth what the conference believes to be the principal causes of industrial unrest, such as the high cost of living, spectacular instances of excessive profits and of misuse of wealth, loss of personal contact in large establishments between employer and employee, and many other less important but by no means negligible factors. Attention is called to the fact that industrial problems vary not only with each industry but with each establishment. "Therefore the strategic place to begin battle with misunderstanding is within the industrial plant itself. Primarily the settlement must come from the bottom, not from the top." Approval of employee representation is expressed, but it is stated definitely that this is not a field for legislation, because the form that this representation should take varies with the individual plant. "Employee representation offers no royal road to industrial peace. No employer should suppose that merely by installing some system of shop-representation he can be assured without effort of harmony and increased production. Doubtless there will be failures where this plan is adopted as a fad or a panacea. It is only a means whereby sincerity of purpose, frank dealing, and the establishment of common interests may bring mutual advantage."

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In the frank acceptance of collective bargaining the conference sees the most helpful approach to industrial peace, and states its belief that the great body of employers of the country accept this principle. The difference of opinion is in regard to the method of representation. Bargains of certain kinds between employers and employees do not lend themselves readily to legal enforcement, and the belief is expressed that, for the present at least, enforcement must rest mainly upon good faith.

"If the joint organization of management and employees in the plant or industry fails to reach an agreement" the report says, "or if without such joint organization, disputes arise which are not settled by existing agencies," a system of settlement through a National Industrial Board, Local Regional Conferences, and Boards of Inquiry is proposed. The Regional Conference proposed would consist of four representatives selected by the parties to the dispute and four others in the industry chosen by them and familiar with the problems at issue. A regional chairman, representing the Government, would preside over the Conference and act as a conciliator. If a unanimous agreement should be reached, it would have the same effect as a collective bargain reached by joint organization in the shop.

If a unanimous agreement is not reached, the question, with certain restrictions, must go to the National Industrial Board, unless the disputants prefer a mutually chosen umpire. Meanwhile, both parties to the dispute must agree that there shall be no interference with production pending adjustment. If one or both of the parties refuse to submit the dispute under the procedure above outlined, the regional chairman forms a Regional Board of Inquiry consisting of two employers and two employees from the industry and not parties to the dispute. This board may subpoena witnesses and records, and publish its findings as a guide to public opinion.

The National Industrial Board at Washington would have general oversight of the workings of the plan, which in addition to being applicable to public utilities, provides machinery for adjustment of wages and working conditions of government employees. The plan involves no penalties other than those imposed by public opinion. It does not deny the right to strike, nor does it impose compulsory arbitration, merely virtually compulsory investigation.

Other parts of the report advocate a six-day week and the fixing of hours of labor at a point consistent with the health of employees and with proper opportunities for rest and recreation. A basic living wage is also endorsed. Profit-sharing, it declares, while furnishing a field "in which sincere experiment may add a real knowledge of desirable procedure", nevertheless cannot be considered as affording a complete solution of industrial problems. Attention is called to the fact that the prohibition of child labor is merely a negative measure, and that proper education, physical training, and vocational guidance for the child are essential to the general welfare.

The report also emphasizes the point that while industrial unrest has been increased by war conditions, the fundamental causes for misunderstandings were present in pre-war times and will continue if not checked, irrespective of after-war readjustments.

Shortly before the report of the Conference was made public, that of the committee on labor relations of the Cleveland Chamber of Commerce dealing with some of the same general subjects appeared. This report is of particular interest because it was signed by the two labor members of the committee, namely, the heads of two transportation brotherhoods, the engineers and the trainmen, as well as by 24 other committee men not directly connected with labor organizations. This report declares for collective bargaining. "Employee's representatives should be duly accredited, be chosen by the employees from among their own number, unless otherwise agreed by employer and employee, and be empowered by the employees to negotiate for them. Such negotiations should be under control of the parties immediately concerned. When employees in any establishment desire to do so, they should have the opportunity of choosing, without restriction on the part of the employer, a competent adviser or advocate to meet with representatives chosen by and from among the employees in negotiations with their employer. Representatives of employees, selected by and from their number, should be assured that no discrimination will be made against them by their employer because of anything said or done in their representative capacity. In those industries where an establishment cannot practically be the unit of representative negotiation, the principle of representative negotiation between a group of employers and groups of employees is advocated." While the committee advocates the open shop without discrimination it makes no objection to an agreement between an employer and his employees to maintain a closed union or a closed non-union shop or department, where both parties desire such an agreement.

An important part of the report deals with the need for frankness on the part of the employer in acquainting his employees with the facts regarding conditions of business and employment, even to the point of opening the concern's books to show the fairness of a given rate of wages. The eight-hour day and the Saturday half-holiday are endorsed. Intimidation by violence or by blacklisting is condemned. The employee's right to strike and the employer's right to lockout are both declared to be subordinate to the public's right to service. The committee also declares its belief that "the most powerful force to bring about desired conditions is the opinion of an informed and enlightened public".

Resolutions and committee reports in themselves accomplish little if anything. Translated into action, however, by their readers, even though there is no force except public opinion behind them, they may mean a great deal. It is encouraging that, with both these reports, men representing divergent interests were able to agree on a definite program, covering not only the statement of general principles but also making specific recommendations regarding remedies.

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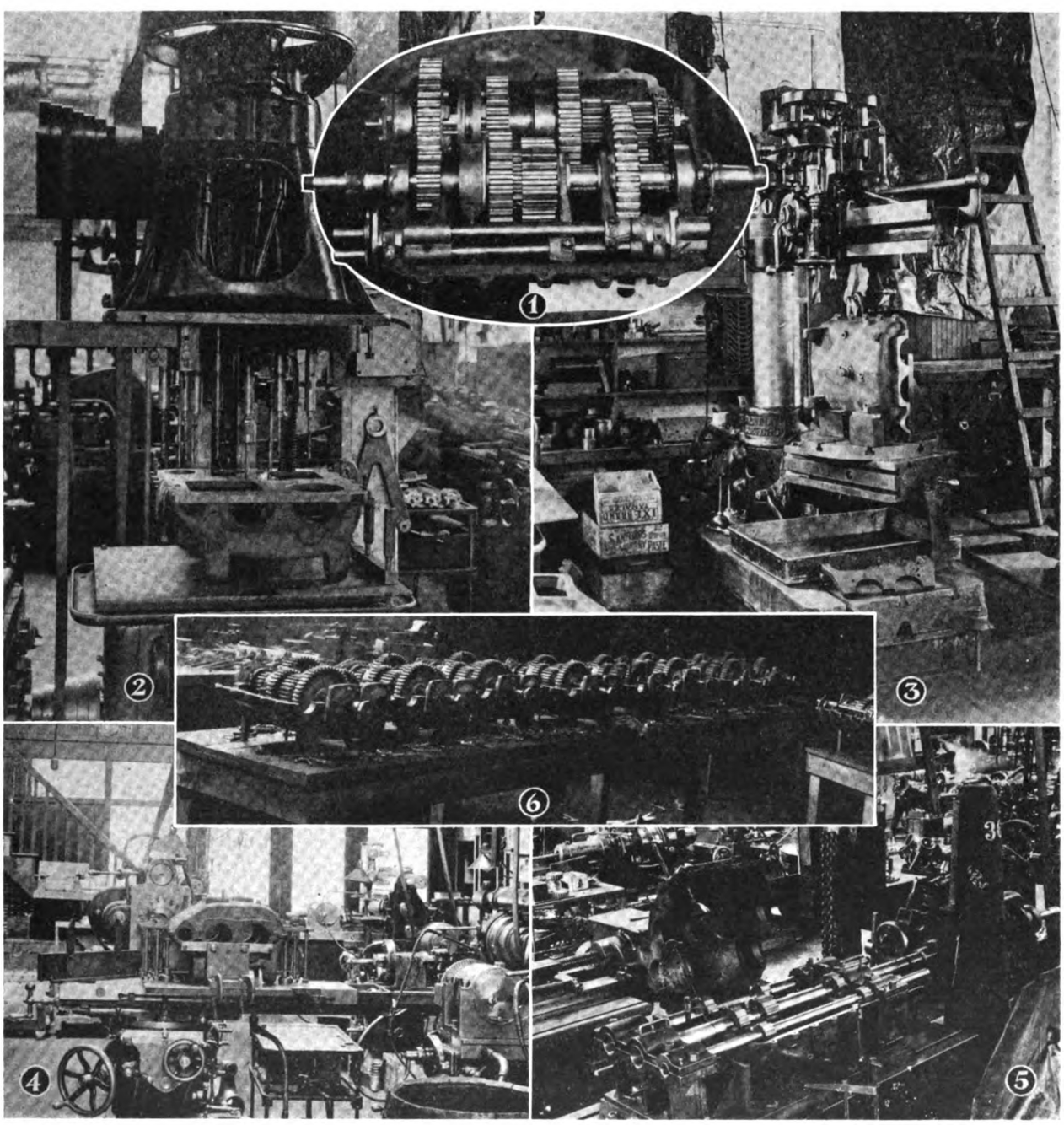
Some Machining Operations on Fageol Transmission-Cases

By O. E. BACH*

The machining operations to be described are on the case of the seven-speed transmission being manufactured in quantity by the Johnson Gear Co. for the Fageol Motors Co. for use in its 3½ and 5-ton trucks. The transmission itself embodies some new principles in design and is worthy of description. Although it has no greater number of gears than the ordinary four-speed transmission, through the use of a variable-speed countershaft controlled by a separate lever, five forward and two

*Equipment manager, Johnson Gear Co., San Francisco.



MACHINING OPERATIONS ON TRANSMISSION-CASE SHOWN IN FIG. 1. FOR DETAILED DESCRIPTION SEE TEXT.

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reverse speeds are obtained. The direct drive is on the fourth speed, and the fifth is obtained through an overgear, which makes a greater speed possible without increasing the speed of the motor. By engaging either one of two constant-mesh gears with a sliding clutch, the use of either of two separate transmissions is obtained. The extra speeds included in the design are made necessary by Californian conditions. The low speed is advisable for starting heavy loads and for the mountain grades. The extra high speed can be used to advantage on the level Californian highways where little power is necessary after the load is once started. Many long trips are made with trucks loaded only one way. On the empty return trip it is desirable to be able to travel at touring-car speed.

The gears, ball-bearings, containers, etc., are machined in quantity lots. The shafts and small screw machine parts are manufactured on automatics. The gears throughout are made of No. 6140 Society of Automotive Engineers analysis steel, a chrome-vanadium product of 0.40% carbon content. The gear-teeth are roughed and finished on Fellows gear-shapers. They are then inspected on centre-testing jigs for backlash and eccentricity before heat treatment. After heat treating the bore is ground true to pitch-lines.

The main bearings throughout are mounted on Timken roller bearings. The idle running gears are mounted on Hyatt bearings. All the gears and bearings are constantly submerged in oil. Gauges, jigs, and templets are controlled by a set of Johannson blocks. This ensures interchangeability of all parts. Fig. 6 shows the progressive assembly of the transmission units and gives an idea of their interchangeability.

Both upper and lower cases are of cast-iron. They are first cleaned of all scale and sand by sand-blasting. They are next ground on the joints on a disc-grinder. The four lugs on the bottom of the lower case are also ground. The two larger of these are for the purpose of holding the strut-rods. The two others are cast on for the purpose of holding the case level during the machining operations. Fig. 2 shows the bolt-holes being bored on a 12-spindle Pratt & Whitney drill. The holes are located by a fixture with bushings hardened for wear. This fixture is reversible and is used for drilling both upper and lower cases. As shown in Fig. 3, the holes for the strut-rod are drilled in the lugs on a Cincinnati-Bickford radial drill. The case is clamped to the angle plate and the jig is located from bolt-holes in the end of the case. The jig is shown in the foreground.

The cases are then bolted together and the ends faced square and parallel on a No. 3-A Brown & Sharpe universal milling machine, shown in Fig. 4, using a 10-in. inserted-tooth high-speed milling cutter. The lower half of the case is located on the machine by the jig shown at the left of the picture. The jig is fastened to the bolt-holes in the lower case by dowel pins, and is located square with the face of the cutter. The top half is bolted on and both halves of the case are milled in one operation. The case is reversed and the milled end is clamped to the angle-plate shown in the illustration and the opposite end milled, the distance between the faces being set by the master-bar also shown at the left of the illustration. This ensures the interchangeability of all upper and lower halves.

The next operation as shown in Fig. 5 is done on a boring fixture on a Barnes horizontal mill. This operation rough-bores, finish-reams, and faces all bearing-housings. The upper half of the case is shown removed to allow for the insertion of the cutter-bars. The two halves are then clamped together before boring. The case is located from the same bolt-holes as in the previous operations. The fixture is so designed that the case parts exactly on the centre line of the bearings. The case and the fixture are stationary. The cutter-bars travel horizontally in the guide-bushings on fixed centres corresponding to the centres of the gear-shafts and the shift-rod mechanism.

The cases are next drilled and tapped in the ends for the bearing supports and also for the reverse idler-pin. the drain-plug, breather-pipe, and the hand-hold plates. All these operations are done with jigs on multiple-spindle and sensitive drills. The case is thoroughly cleaned and inspected and the inside painted with red lead to guard against any grit remaining. It is then sent to the assembly department. All finished cases before acceptance are subject to a running brake test to eliminate minor noises due to slight distortion in gears from heat treatment.

Each year the Pacific Coast plants are making a larger proportion of the parts used in the trucks and tractors manufactured or assembled in the Western States. The facilities are here for turning out this work just as well as in any other part of the country. Given a demand large enough to justify tooling-up for quantity production the Pacific Coast can meet the East in price and quality and offer the added advantages of better delivery and service.

THE late Henry Irving, at a reception in Philadelphia, narrated some of the memories of his youth.

"My touring days," he said, "seem distant, and yet very clear to me now. I recall with particular pleasure a melodrama of crime in high life wherewith I toured the provinces for two successful seasons.

"My part called, in the first act, for a dark stage. In this darkness I fought with an old earl, threw him heavily, and, when he did not rise after his fall, I cried out:

"Great heavens! What have I done?"

"Usually this scene impressed my audience tremendously, but I remember one night, when a coster turned my outcry and the darkness and the old earl's tragic fall into ridicule and laughter.

"I have never seen that coster, but I remember his voice—a slow dry voice. The old earl had dropped heavily, and in the silent obscurity I had cried: 'Great heavens! What have I done?' when the coster spoke up:

" 'Strike a light, young feller, and we'll have a look."
—Washington Star.

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Group Life and Disability Insurance

By GAYLE G. MOSELEY*

The majority of employers honestly desire to do something for their employees that will, in a substantial manner, express their appreciation of the services of those associated with them in industry. Many forms of industrial welfare work have been tried, and while there has been something of value in most of them, there has seemed always to be something lacking to make the plan entirely satisfactory to all parties concerned. It has seemed that one of the things that has lessened the value of the usual form of welfare work has been a lack of confidence of the employee in the employer. The employee has felt that whatever efforts the employer made in his behalf were from selfish motives, and therefore has not received the benefits in the kindly spirit in which they were offered. There has been a lack of confidence in the motive of the employer.

A few years ago, someone conceived the idea that if the employer insured the lives of his employees for the benefit of the workman's dependents, that this would be something which would benefit the employee, and which could not possibly be any direct benefit to the employer. When this form of insurance was put into operation it immediately gained the approval of the employee and his family, because his dependents recognized the fact that if the employee should die from any cause they would have sufficient funds immediately to meet the necessary living expenses, until such time as their affairs could be rearranged, and plans for the future made.

That this form of insurance has been satisfactory is shown by the fact that today over a million industrial workers are insured under group policies. These group policies are written without medical examination, and the rate is based upon the age and the working conditions of the employees. There are several different forms of policies issued. One plan is to insure all employees who have been employed from three months to one year for $1000, one to two years, $1100; two to three years, $1200; three to four years, $1300; four to five years, $1400; office and department heads, $2000 to $3000. The cost of this plan is likely to be about $11 for each employee of more than three months service. Another plan is to insure each employee for the amount of his annual wage or salary, with a minimum of $500 and a maximum of $3000. The cost of this plan averages somewhat less than 1% of the payroll. Another plan is to insure each employee for the same amount, usually about $1000. The cost of this plan averages about $9 for employee insured. The most satisfactory plant, we believe, is to begin with a smaller amount of insurance, say $300, and grade this according to the earning ability of the employee, and then increase the amount of insurance each year. This plan offers increasing insurance as a reward of continued service.

Another form of insurance that is proving perhaps more popular with the employee than any other is group disability insurance. This provides a certain benefit to the employee in case of sickness or of accidents which are not taken care of under the compensation law. The policy is issued providing one of several plans of coverage designed to meet the requirements of employers. The benefits to be paid can be either a uniform amount for all employees or a variable sum equal to some percentage of each employee's weekly wage. This policy provides protection for the disabilities not covered by the Workmen's Compensation Act. Therefore, if these two forms of insurance are carried, the employee is protected at all times.

One great advantage of this form of insurance is that because of the frequency of disability the insured employees are having constantly impressed upon them the value of the protection. Each employee to whom benefits are paid becomes, upon his return to work, an enthusiastic supporter of the plan that provided him with an income during his disability. An employee soon realizes the advantages to be gained by remaining where these benefits are enjoyed, and he will hesitate to change his place of employment without some good reason. It also makes it much easier to secure new employees, and what is more important, attracts the better class of employees who want good permanent jobs. This form of insurance has probably done more to reduce labor turn-over than any other plan so far devised.

The cost of group disability insurance is dependent upon so many factors that any general figures would be misleading. For instance, policies may be written so that payments commence at any time from the date of injury or sickness to two weeks after that date. Manifestly, under the latter arrangement, not only is the amount of payment in each case reduced somewhat, but the number of cases where payment is made is materially decreased. Both these considerations reduce the cost of the insurance. Further, the payments during long disabilities may terminate at the end of 26 weeks or of 52 weeks. With both the above factors, the cost is within the control of the employer. Within certain limits, he can get just as much or as little as he chooses to pay for. Other factors not directly within his control but which affect the cost of disability insurance are the average age of the employees and the character of the work on which they are engaged. Furthermore, records show that women in industry are more liable to disability than men, so that where the proportion of women employees exceeds 20%, the rate of insurance is increased, rising with each additional 5% of women employees.

*Director medical and welfare departments, Aetna Life Insurance Company.

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An interesting development of group life and disability insurance is the occasional sharing of the cost of insurance between employer and employee. This usually takes the form of the employer paying the whole cost of the life insurance, and the employee, if he desires to take out disability insurance at the same time, paying the premiums on the disability policy. These premiums are, of course, somewhat lower than the employee would have to pay on an individual policy giving him the same protection.

Adjusting the Wage-Scale to the Cost of Living

Increases of wages to meet increased cost of living have been practically universal during the past five or six years. Of the increases other than those granted under the duress of strikes, some have been made to fit individual cases, while, on the other hand, many concerns have made a practice of horizontal increases of compensation covering the entire working force. While these latter increases were usually intended to correspond approximately with increases in the cost of living during the period since the previous adjustment, the rate of increase selected was usually the result of little more than intelligent guesswork. A recent bulletin of the Taylor Society, however, tells of one firm, employing about 1000 workers, that has undertaken to base its wage policy upon the results of thorough investigation of actual costs of living in the district where its employees lived.

The management took the position that an educational campaign was necessary to bring employees to realize that production is the only possible remedy for scarcity of goods, which in turn is the reason for high prices, and that any interference with production by strikes or otherwise merely aggravates the trouble and intensifies the very condition against which they protest. To quote from the report:

"There is no better place to begin such a campaign than in our own factories and among our own workmen, and it is plainly up to the management to take the initiative. This means a careful analysis of the wage conditions, due regard being given to the current purchasing power of the dollar, and practical application of our findings to the solution of our own problem. We believe it fair and practical to "give more in order to get more", and in the recognition of the relative increase in living cost, as compared with the relative increase in wages in any given period, we are only laying the foundation for better conditions and better relations between men and management, which in turn will lead to the ultimate end of maximum production from any given set of conditions or facilities; and for the coincident results, such as maximum wages, minimum costs, low labor turnover, equitable profits on capital invested, and mutual success and satisfaction to all concerned, namely, the worker, the manager, the owner, and the community of which these three are members.

"If we do not recognize this factor in our wage relations, then we are bound to pay for it one way or another. Briefly, when an individual finds his income does not permit him to maintain the standards of living to which he has been accustomed (to say nothing of reaching the higher standards which human nature inherently desires as men advance in years) he soon gets into a frame of mind where he is torn between (1) lowering his standards of living by omitting certain articles of diet—making the old suit last another year, moving to cheaper quarters, or practising other economies or substitutions—and (2) 'hitting the boss for a raise'.

"It seems that the individual does not let himself be 'torn' very far in either direction. He quickly acts in the direction of (2), and if the answer is not favorable or not promptly given, individual dissatisfaction soon arises, and like the proverbial bad apple in a barrel of otherwise good ones, he soon contaminates the others. The manager soon sees an element of unrest increasing; strikes may, and in fact do follow, as witnessed by the hundreds of them occurring of late, all of which have had as their motive, or at least a part of that motive, the 'recognition in wages of the increasing cost of living'. Why, then, should we overlook the obvious, or dodge the inevitable? Should we not expect to meet the increasing cost of labor as we do the increasing cost of raw materials by providing in the selling price of our respective products a suitable margin for increased labor costs, which in the main will, and do result, more from increased cost of living than from any other cause?"

A questionnaire regarding family expenditures was sent to a selected list of employees equally divided among unskilled, semi-skilled, and skilled workers. From the answers to this questionnaire and from studies of recorded prices it was determined that the cost of living for its employees during 1919 was 81.6% higher than it was in 1913. Examination of payrolls showed an average increase of 67.1% in wages during the same period. Although the increases thus far had not been absolutely uniform for all classes of workers, it was decided to make no discrimination but to give a horizontal increase affecting all classes and bringing the total increase since 1913 as nearly as possible to 81.6%. Wages are to be revised from time to time in accordance with changes in the cost of living.

The result of this voluntary action on the part of the management is summarized as follows:

"(1) The majority of our men when they received this raise, and knew the circumstances under which it was given, were highly pleased with the company's attitude. Many of them expressed their personal satisfaction to their foremen, to their fellow workers, and to their friends in neighboring plants.

"(2) It further established their faith in the watchfulness of the management over the conditions affecting the workers, and showed the workers that it was not

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necessary for them to resort to the prevalent methods of securing attention or recognition.

"(3) It paved the way for further action on the part of the management in its work of installing scientific management principles to the operation of the business, and through this practical demonstration of the interpretation of Taylor's statement that the "principal object of management should be to secure the maximum prosperity for the employer, coupled with the maximum prosperity for each employee", our men have taken hold in a hearty manner and are assisting in many ways to achieve the ideals so admirably set forth in Taylor's 'Principles of Scietific Management'.

"The cost of this increase, as distributed over our annual production, will be relatively insignificant, for while this wage increase averaged $0.0364 per hour applied to each of 1184 men, or, expressed otherwise, it was approximately 10% increase in its net effect on our annual payroll, we can see wherein the reduction of wasted effort and the practice of other economies as the result of improved methods of management will more than compensate for this increase.

"But this is not the end of it all! By standardizing our method, and by semi-annual or quarterly review of the changing prices, we will continue to make adjustments in recognition of the cost of living whenever conditions warrant such action. In other words, it will be treated as a perfectly proper and legitimate factor in our business affairs."

Red Cross Trilby Thrills Shopkeeper

The Red Cross Commissioner to Rumania was giving a grand ball in Bucharest, to be attended by Queen Marie and the diplomats of twenty-five nations, and the young women of his staff wanted to look their prettiest. It was the one official occasion when the Red Cross workers were permitted to go in civilian dress. They decided to attend the social function in formal evening clothes—as nearly correct in details as they could manage with their meagre wardrobes.

Heavy walking-boots, worn with the Red Cross uniform, are excellent from the standpoint of comfort and endurance. They are just what one wants for mud, snow, and ice, but they are hardly the thing to set off a party gown. So one of the young women workers started in search of a pair of dress shoes or slippers. In Bucharest's largest shoe-store, the salesman took one look at her stoutly clad feet, and shook his head hopelessly.

"I'm sorry," he said, "but we can't fit you. We sold our large pair to an American lady yesterday."

MILLICENT complains that prohibition hasn't helped things at her home at all. "Why, we could always find father in some cafe within a radius of four blocks," she declares. "Now we have to hunt all over Cuba for him."

Accident Prevention

By T. F. JENNINGS

The 'Safety-First' movement originated in William H. Tolman's studies of accident prevention abroad. In 1900 Dr. Tolman started the American Museum of Safety in New York. This was the first organized movement against preventable deaths and injuries. The 20 years battle against accidents has materially reduced the casualty rate. More important, it has caused an analysis of accidents so thorough that we are all becoming experts on dangers to be avoided. Statistics bear out the claim of Safety-First authorities, that 80% of the accidents are due to carelessness.

There are few accidents in the dynamite industry. The workers know that they are in the presence of death. They have 'demonstrated' that personal caution is the most effective preventive of accidents.

Investigations by large employers of labor, such as the General Electric Co., have revealed that there are certain ages, certain hours, certain days when people relax their vigilance. The most careless age is 22 to 26. More accidents occur on Monday than any other day. More accidents occur between 9 to 10 in the morning than during any other hour of the day or night.

It is evident that people have a tendency after a period of rest, to return to work in a careless attitude. The relaxation of the body is accompanied by a relaxation of vigilance and caution. The prevention of accidents can never become automatic. Safety devices help materially, but human caution is the most powerful protection against injury.

Franklin K. Lane, former Secretary of the Interior, recently issued the following statement: "In mines, in a large number of our most important industries, 50% of the people working there are foreign born, and they have signs printed for their welfare and to protect them, and these signs have to be printed in seven or eight or nine different languages, and many of the people cannot read them in any language. In the mining industry alone, it has been estimated that we can save at least 150,000 accidents a year if those people can be taught to read enough English to understand the signs and directions that are placed before them. Now we have got to turn ourselves into a council of progress and frame a national purpose. We are the prophets of a new day. It means that democracy, in essence, is that every man has a chance. It means, primarily, the very thing to be done now, is that we shall put into the hands of every man born in this country the tools by which he can open the archives of Americanism. If we can do this, we will produce the greatest of all nations and a new race that will long hold a compelling place in the world."

THE couple were married at the home of the bride's parents, where they will remain until the groom gets a position.—Centralia Messenger.

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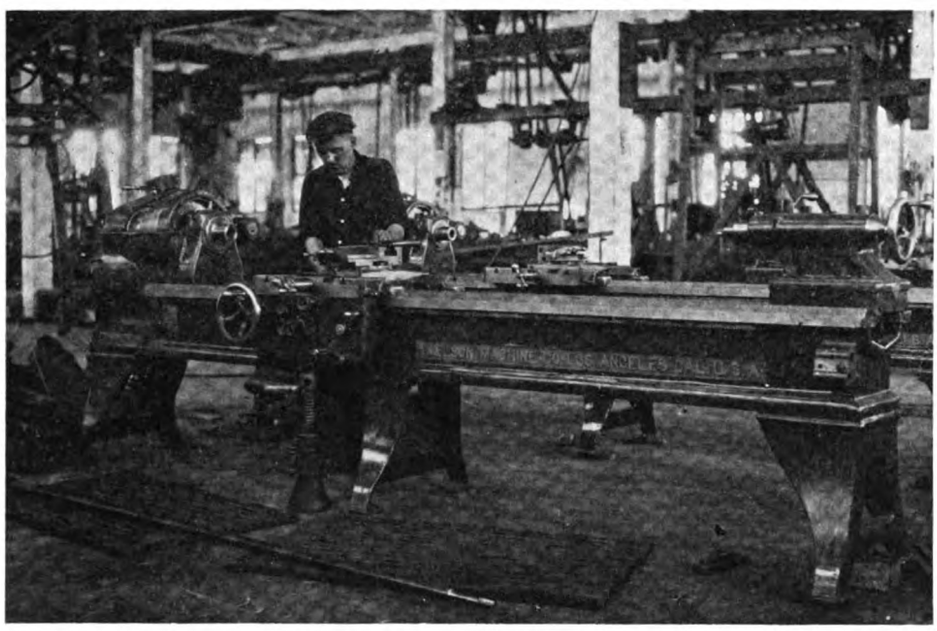
A Californian Manufacturer of Machine-Tools

By DOUGLAS W. CHURCHILL

Nearly thirty years ago, C. F. and G. A. Axelson opened a small machine-shop under the name of the Acme Iron Works, which name was later changed to the Axelson Machine Co. This was about the time that oil was discovered in the old Los Angeles City field. Beginning with a general jobbing trade the company gradually developed a manufacturing business in oil-well tools, particularly pumping machinery, until at the present time Axelson equipment is known in every oilfield in the world. The growth of the company's business is indicated by the increase in the floor space of its plant from the 2700 sq. ft. of the original shop to the 102,740 sq. ft. of the present plant. This article, however, deals not with the company's principal line of oilfield equipment, but with the manufacture of heavy-duty lathes, which has been taken up during the past few years, and which is particularly notable because the Axelson company is the only concern west of the Rockies that makes machine-tools on a commercial basis.

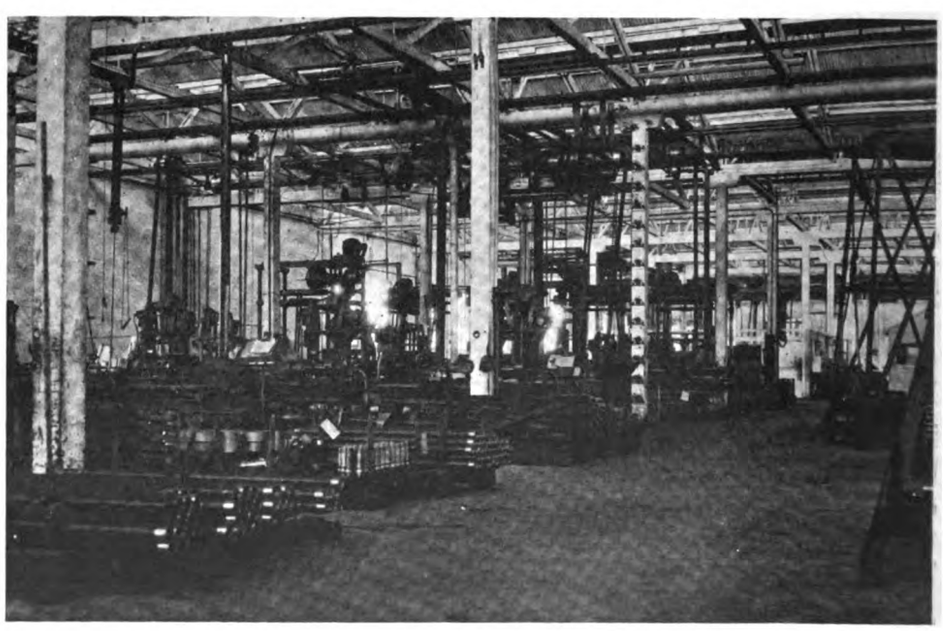


ASSEMBLING AN 18-IN. AXELSON HEAVY-DUTY LATHE

The first lathes made by the company were designed by C. F. Axelson in 1910 for use in the company's shops. These were so satisfactory that several were made for plants of associated companies. It was not until 1914, after a service-test of four years had demonstrated their merits, that the company decided to put these lathes on a production basis and manufacture them for the general market.

To meet Eastern competition, particularly in a line such as machine-tools, is no light matter, and it was, and is, something requiring careful study. In the first place, the company decided to specialize on one type of machine, namely, a heavy-duty lathe, which is made in three sizes, 16 in. by 8 ft., 18 in. by 8 ft., and 24 in. by 10 ft. This limitation of models makes it possible to maintain a complete stock of lathes and parts without tieing up an excessive amount of capital, and, together with an efficient system in the stock-room, permits the shipping of any ordinary-sized order within a few hours from its receipt.

On account of differing ser-



PART OF THE MAIN MACHINE-SHOP AT THE AXELSON PLANT

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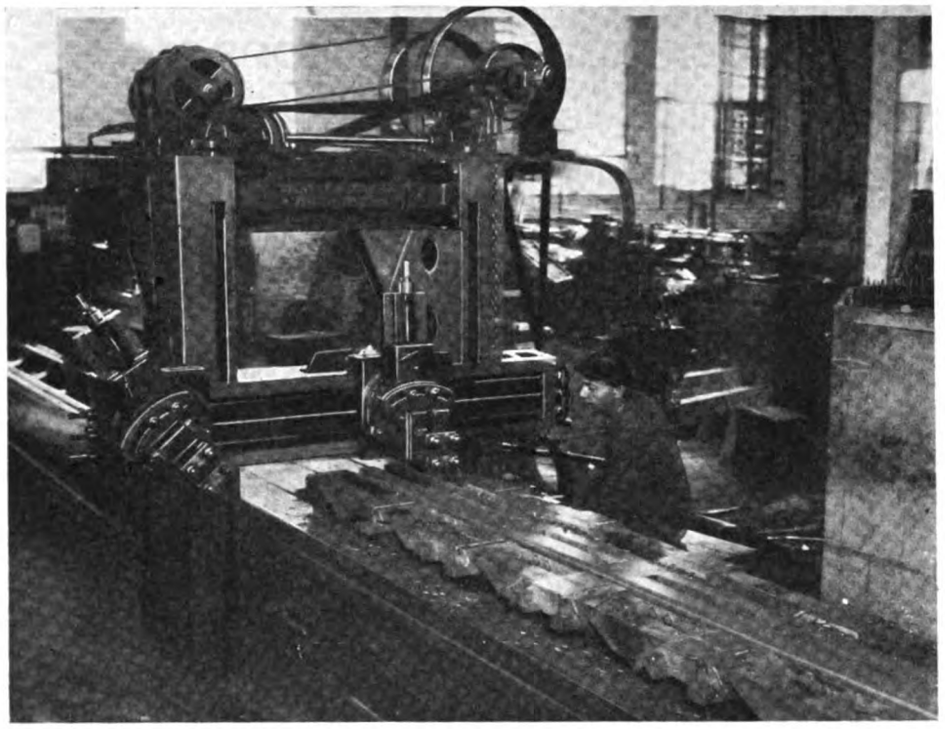

A GRAY PLANER MACHINING SIX AXELSON LATHE CARRIAGES AT ONCE

vice conditions, the materials used for the various parts of the lathe differ considerably. Thus the bed is a close-grained semi-steel. The cupola-mixture used is composed of 30% steel scrap, 50% high-manganese pig-iron, and 20% 'remelt' of defectice castings and foundry-scrap. On the other hand, the carriage is a soft gray Alleghany iron, so that all the wear comes on the carriage and is evenly distributed. If the carriage were made as hard as the bed, some of the wear would come on the latter, and a 'bow' would be worn in it, while, with the method chosen, accuracy is maintained even after long service. The head-stock, tail-stock, and carriage-apron are also of softer metal than the bed. Other parts of semi-steel include the head-stock cone and back-gear quill.

The lathe consists of five assemblies, the head-stock, bed, carriage, gear-box, and tail-stock. Orders for equipment are written in duplicate, the original going to the stock-room, where each part of the lathe is assembled. The duplicate order is sent to the foundry, and work is started on an equal number of parts to those taken from stock.

After the complete lathe is assembled, it is tested for alignment of bed and alignment of face-plate, compound-bridge, and tail-stock with the bed. Then a 12-in. boring and turning test is made, the limit of error allowed being 0.001 inch in 12 inches. The face-plate is tested by turning the plate, with one of the regular lathe-tools set in the tool-holder and against the plate.

With methods of production that permit the sale of first-class machines at a reasonable price and with the ability to ensure quick deliveries both of parts and completed machines, the Axelson company has nothing to fear from Eastern competition, and has built up a machine-tool business that may ultimately even overshadow its trade in oilfield equipment.

Paper Clothes — But Not as Raincoats

Paper clothing may be quite the thing at fancy-dress parties but if worn in a rainstorm—well, one should then carry a rubber mackintosh, or a barrel.

Prince Liechenstein of Klagenfurt will testify to the timeliness of this admonition. The prince, who hails from the Tyrol above Trieste, has been wearing a suit made of nettles and brown paper. Hs is one of the many Carinthian nobles that fell from power when Austria became a democracy. During the revolutionary disturbances he lost all his personal wardrobe, and bandits, who swarm in the locality of his castle, recently relieved him of all his military uniforms, and even the tapestried covers of his chairs. The prince, who is now a subject of Greater Serbia, appealed to the American Red Cross for aid.

Recently, while taking a walk up the world-famous castle-crowned hill near Klagenfurt, the former ruler was caught in a rainstorm. His paper suit peeled in spots but he was able to get to shelter before it had completely dissolved.

British couriers came to his rescue and gave him a complete private's outfit while the paper suit was drying beside a hot fire. A vagrant breeze blew the drying suit against the stove and when rescued it was charred beyond salvage.

The American Red Cross has distributed many tons of old American clothing to the poor of Bosnia and other localities, but despite these supplies, paper clothing is still in general use throughout Bosnia, Croatia, and what was once Lower Austria.

A COLLEGE professor of alleged distinction had lectured to the eight-year old pupils on necessity for saving and utilizing all things at one's command. He ran the scale from food to coal and re-made gowns, to water, fuel, electricity, and what not. At bedtime that night a girl of eight was stroking her hair with a rubber comb and the absence of humidity and the low thermometer caused the familiar crackling sound.

"What's that," mamma?" she queried.

"Electricity in your hair, my dear," said the mother, all the while hoping that she'd be spared confusion sure to attend an explanation of what electricity was and how it got there.

" 'Zat so?" said the small daughter. "Well, I've got electricity in my hair and grandmother has gas in her stomach and yet we go and buy kerosene."—Los Angeles Times.

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Machining Operations on Pistons

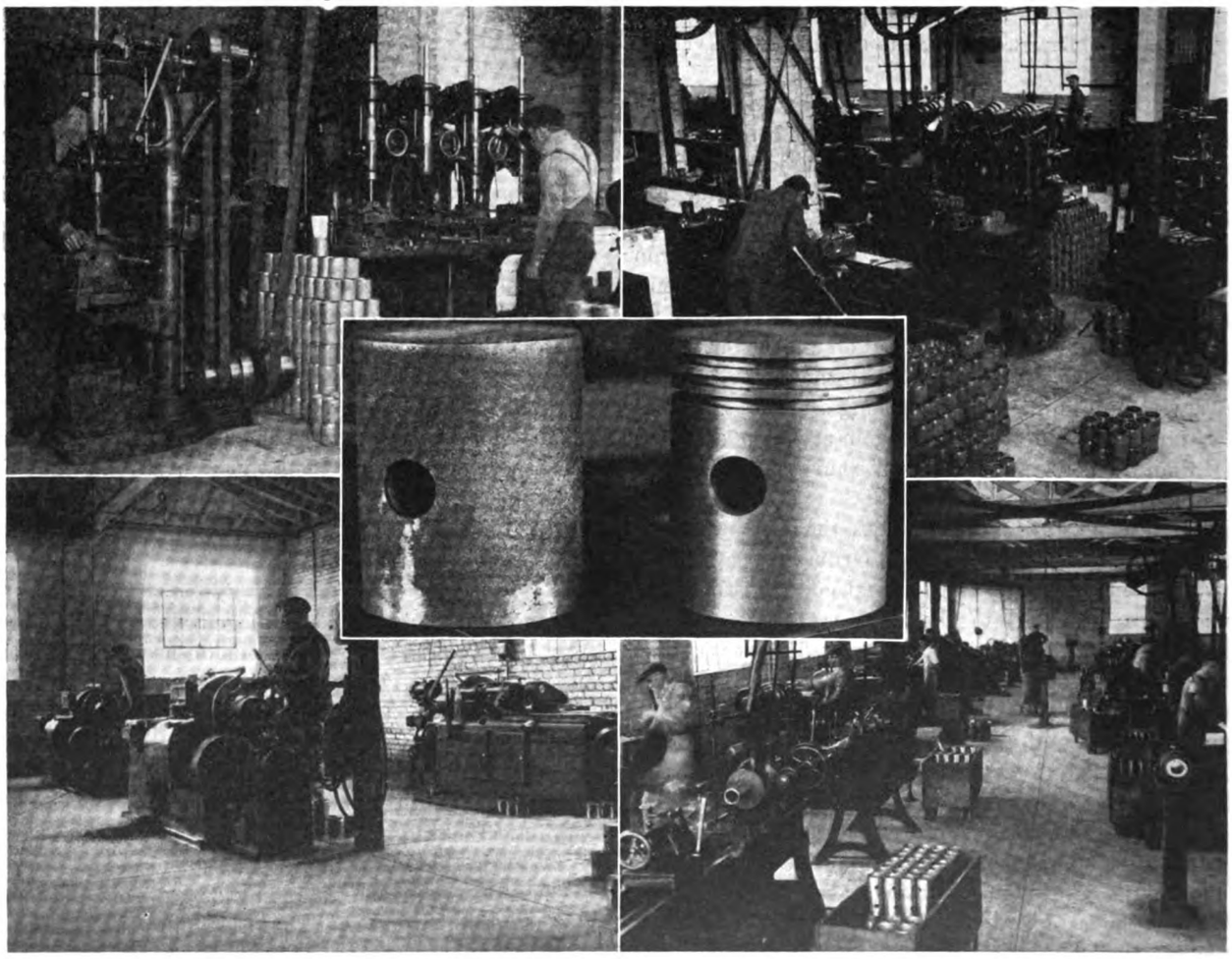
By DOUGLAS W. CHURCHILL

Six minutes from the casting-floor to the stockroom, with a force of one-third the men usually employed in a shop of similar capacity, is the record maintained by the W. H. Jahns Co., of Los Angeles, manufacturers of semi-steel pistons for internal-combustion engines. Only by the use of modern methods and equipment is such a performance possible.

Both steel scrap and pig-iron are analyzed before charging and the proportions in the cupola charge adjusted in accordance with the analysis. All molding is done on machines. The present capacity of the foundry is 500 pistons per day, and this output will be increased as soon as an addition, now under construction, is completed. All patterns used are of metal.

The first machining operation on the rough casting faces the skirt and centres the inside. Next the pin-holes are drilled with a gang-drill. For the next operation a battery of five Potter & Johnston automatic machines of special design have been installed. In this operation the head is faced, the outside diameter is turned, and ring-grooves are cut, all at one set-up. These automatic machines have proved so satisfactory that several additional machines have been ordered and will be installed during the coming summer. In the final operation, which is done on smaller automatic machines, the turning of the pistons and ring-grooves is completed. After each operation, a rigid inspection is made, which not only prevents defective pistons from reaching the stockroom, but also eliminates as much as possible the doing of expensive machine work on defective parts.

When the pistons leave the factory they are only semi-finished, the fitting and final grinding being necessarily left to the purchaser. For this reason, all pistons are made 3/32 in. oversize. The extent of the company's



CENTRE, PISTON AFTER FACING THE SKIRT AND CENTRING, ALSO COMPLETED PISTON. UPPER RIGHT, FIRST OPERATION, CENTRING PISTON AND FACING SKIRT. UPPER LEFT, DRILLING PIN-HOLES IN SMALL PISTONS ON GANG-DRILL AND SINGLE DRILL FOR DRILLING LARGE PISTONS. LOWER LEFT, FACING HEAD, TURNING OUTSIDE DIAMETER, AND CUTTING RING-GROOVES IN ONE OPERATION ON POTTER & JOHNSTON AUTOMATIC MACHINES. LOWER RIGHT, MISCELLANEOUS FACING WORK ON PISTONS.

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operations is indicated by the fact that 600 patterns for automobile, tractor, aeroplane, and ordinary gas engines are kept in stock. The company has established branches at San Francisco, Seattle, Salt Lake City, and other cities, where a complete line of its pistons may be obtained.

Two Famous Letters From Mr. Hoover

The first is the letter written to Mr. Coudert on the occasion of President Wilson's partisan appeal on the eve of the Congressional elections in 1918. The second is his letter to Mr. Arnold, the chairman of a committee at Los Angeles that wanted to work in behalf of his nomination to the Presidency. Our readers will be glad to have the full text of these important statements.

November 2, 1918.

Frederick R. Coudert, Esq.,
134 East 56th Street, New York City.

My dear Friend:

I have yours of November 2nd in front of me.

My own views are summarized in a word: that we must have united support to the President. In the issues before us there can be no party policies. It is vital that we have a solid front and a sustained leadership.

I am for President Wilson's leadership not only in the conduct of the War but also in the negotiation of peace, and afterwards in the direction of America's burden in the rehabilitation of the world. Our object in this war is to see the establishment of governments in the Central Empires that are responsible to their people. This is the vital safeguard to permanent peace. The passing of their militaristic autocracies must be and is rapidly being marked by such treatment as to put that system out of action forever.

There is no greater monument to any man's genius than the conduct of negotiations with the enemy by the President. There has been a steady growth of realization by the German people and her deluded Allies of the debauchery into which they and the world have been plunged by militarism. The President has by his conduct and word stimulated this realization. He has assured them justice if they themselves will throw off their yoke and he has not hesitated in application of our every resource in force against their military dictators.

If the final overthrow and surrender of autocracy can be accomplished through the German and their allied peoples themselves, the President will not only save the lives of a million American boys and countless innocent women and children, but will have attained more complete victory and a more permanent guarantee of peace than any other means. The President's leadership has gained gigantic strides in this course. The terms of surrender are being made by Marshal Foch and our military leaders. The action of the Bulgarian, Turkish, and Austrian people has or is forcing the acceptance of these terms. The German people will sooner or later do so.

Our objects in the overthrow of all autocracies in Europe and the establishment of government by the people is but part of our great burden for beyond this, when these immediate objects are attained, we still have before us the greatest problem that our government has ever faced if we are to prevent Europe's immolation in a conflagration of anarchy such as Russia is plunged in today.

We must nurse Europe back to industry and self-support and we must ourselves avoid entanglement in the process. This can be accomplished only by this same leadership which has the confidence of the great mass of people in Europe. The President has spoken throughout this war the aspirations of the vast majority of the American people. There is no other leadership possible now if we are to succeed in these great issues.

Yours faithfully
HERBERT HOOVER.

March 8, 1920.

Mr. Ralph Arnold,
Engineers Club, New York City.

My dear Arnold:

I have given deep consideration to the urgent recommendations of the Committee of which you are chairman. Such proposals are indeed a great honor, but I feel that I cannot alter the attitude that I have consistently preserved in these matters. It is, however, due to old friends that I should make this position perfectly clear to you and your colleagues.

First, I am an independent progressive in the issues before us today. I think that at this time the issues before the country transcend partisanship. It is well known that I was a Progressive Republican before the war and, I think rightly, a non-partisan during my war service. The issues confronting us are new and the alignment upon them has not yet been made by the great parties. I still object as much to the reactionary group in the Republican party as I do to the radical group in the Democratic party.

Second, I am not seeking public office and consulting my own personal inclination I do not want public office. I cannot prevent any citizen or group of citizens from agitating that I should take public office, but I cannot conscientiously participate in any organization to that end. I belong to a group which thinks that the American people should select their own officials at their own initiative and volition, and that resent the manufacture of officials by machine methods. I feel sure that if I entered the race for nomination to the Presidency, and undertook to solicit and spend the cost of propaganda and organization, this would be in itself a negation of the right American instinct, because of the obligations that it all implies. I thoroughly believe that I, like any other citizen, should always be ready for service when really called upon, but to go out and try to persuade the public to call me is opposed to my every instinct.

Third, I hope to have the affection of my countrymen, but my ambition is to remain a common citizen, ready to engage in team play with any organization and leader-

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ship that has for its objective the consummation and maintenance of great issues in the forms that I believe are to the public interest and benefit. I of course believe in party organization but it must be for the promotion of issues, not of men. I am not a straddler on any issue, I spend most of my time agitating for issues that I believe in. It is the privilege of all of us to hold our own views and it is our duty to express them when called upon to do so. But no man can be so arrogant as to assume that he can dictate the issues to the American people or to the great parties they support.

Fourth, you and your friends have urged that I should undertake to organize propaganda for myself, as representing issues, by entering into competition for nomination by a great party. Aside from the reasons mentioned above, this implies entry upon a road of self-seeking, whereas my view is that I should agitate for the issues, not for myself. You rightly say that joining sheer organization without issues is simply office hunting without regard to public service.

Finally, I am not so ignorant as not to realize perfectly well that such a course does not lead to nomination to the Presidency, but I would not be myself if I started out on a path of self-seeking to obtain any office.

Yours faithfully

HERBERT HOOVER.

Industrial Health Departments

The U. S. Public Health Service has recently issued public health bulletin No. 99, 'Studies of the Medical and Surgical Care of Industrial Workers', by C. D. Selby, consulting hygienist for the Service. The bulletin discusses the general relation of medical service to industry and the various objects in the attainment of which a medical department may be of service to an industrial plant. These latter are listed as follows: Safe healthy places in which to work; machinery, tools, methods, and processes that permit rapid work of good quality, with health and body hazards reduced to the minimum; competent supervision; ascertaining the kind of work for which applicants are fitted; physical supervision; protection from communicable diseases; medical, surgical, and dental treatment; medical and dental prophylaxis; proper nourishment; time and facilities for rest and recuperation; instruction in how to keep well and avoid injuries; assistance in adjusting social and financial difficulties.

The bulletin then gives the results of an investigation of the principal features of the medical departments of about 150 industrial establishments, employing from 200 to 36,000 workers. This includes information as to the equipment used and a number of specimen forms for reports.

One of the most interesting parts of the bulletin is a summary of answers from managers of plants having well-equipped medical departments regarding their value. The concensus of opinion expressed was to the effect that besides such services being rightfully due the men, a medical department reduces labor turnover, and the time lost because of sickness and accident, permits the placing of men in jobs suitable to their physical conditions, and increases good-will and efficiency.

Attention is called to the need of tact in starting, or in making any considerable increase in the activities of, a medical department in order to obtain the confidence of employees, who are likely to be suspicious of any new development in the activities of the company on behalf of its workers. It is shown, however, that the confidence and even the co-operation of employees may be obtained if the proper procedure is followed.

The problem of the concern that employs too small a number of workers to make the establishment of an adequately equipped medical department feasible is discussed. The suggestion is made that frequently such a concern would be able by arrangement with other small plants in the same district to establish co-operative medical departments, the business side of such departments being handled in much the same way as co-operative shipping organizations and similar co-operative activities.

The following general statements and conclusions are given as a result of the investigation already mentioned.

1. Industrial medicine is the theory and practice of medicine applied to the prevention of sickness among industrial workers and their prompt restoration when sickness or accidental impairment have occurred.

2. To be effective, industrial medicine should not be limited to the care of injuries. On the contrary, its value is determined largely by its use in the hygienic supervision of working conditions and the prevention of disease among workers.

3. The relation of industrial physicians to plant organizations should be such as to favor correlation and make for greater efficiency. It is better that they look to the directing heads for authority than to department heads.

4. The engagement of the entire time of a physician seems to be feasible even in relatively small establishments and is desirable in large ones. However, the amount of time that a physician should be required to devote to industrial needs depends upon his ability to make himself useful in the prevention of disease as well as the treatment of injuries.

5. The personnel that may be required to render effective service depends more upon the ability of the directing physician to create demands for the services of his department in health maintenance than upon the number of injuries that are sustained by the workers.

6. Knowledge of the theory and practice of medicine, such as is possessed by the ordinary physician in general practice, does not necessarily mean that the possessor of that knowledge is able to apply it to industrial needs. Physicians who intend going into industrial service

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should seek special training in that direction so as to be able to adapt their knowledge to the requirements of industrial work.

7. A part-time industrial physician is never wholly an industrial physician, and the doctor that renders service in an industrial plant only upon call is usually more of a surgeon than a physician.

8. Doctors that render industrial service only upon request are better paid proportionally than those that render part-time service and these latter are better paid proportionally than those that render full-time service.

9. Trained female nurses are in greater demand as assistants in industrial dispensaries than any other class of attendants.

10. The evolution of industrial medicine and its growing importance is attracting specialists to the industrial field. Prophylactic dental service, an example of this specialization, is becoming deservedly popular.

11. Industrial dispensaries should be accessible. The rooms most used should be most available, and arranged so that passage in and out may be accomplished without confusion. The arrangement of equipment, particularly in the dressing-rooms, should be such as to permit rapid care of patients in an orderly manner.

12. Whole-time physicians render more varieties of service than part-time physicians, and the latter more varieties than detached physicians.

13. While keeping records and making reports are essential to the operation of industrial medical departments, there appears to be a great variety of methods and forms used. There is evidently a need of standardization in this direction.

14. Industrial medicine is not only humane but essential to production. It is beneficial to workers and profitable to employers. It offers splendid advantages to physicians for the development of careers in a field of rapidly growing importance, with great opportunities for service to humanity.

The Physical Examination in Industry

In an address delivered as part of the course on Labor Maintenance, now being given under the auspices of the Pacific Coast Bureau of Employment Research, Dr. Charles A. Dukes, of the medical staff of the Standard Oil Co. of California, called attention to the fact that the aim of industrial medicine is to allow the employee to enjoy the benefits of continuous employment by maintaining his good health through sanitation, preventive medicine, and other agencies. The statement that organized labor is unalterably opposed to the physical examination of employees is unfounded, since Samuel Gompers, speaking officially for the American Federation of Labor, has stated it as his opinion that physical examinations of applicants for employment are necessary in order to prevent the spreading of disease as well as misplacement in work for which the men are not fitted.

Physical examinations of applicants are recommended to eliminate waste due to the employment of the following classes:

1. The physically unfit who must later be discharged.
2. The physically unfit who work with a gradual decrease in efficiency and must finally be discharged.
3. The physically unfit who are therefore subject to accident.
4. The physically unfit to whom accidents not otherwise serious would be fatal because of their defects.
5. Persons with contagious diseases, especially tuberculosis and syphilis.
6. The mentally deficient who can never be successful in their work.

Physical examinations of old employees at stated intervals are recommended for the following reasons:

1. To discover threatened diseases while they are still curable.
2. To discover conditions that would make the employee liable to accident.
3. To make sure of employee's getting the proper treatment.

During a period of five to seven years, the physicians of a large industrial establishment examined a total of 15,938 men, 4620 of whom were old employees, and 11,318 applicants. Of the applicants 2116 were rejected. According to the policy of the company, dismissal of old employees because of physical defects is not allowed. Such employees are either transferred to work for which they are still fitted or else pensioned.

Certain general directions regarding the giving of physical examinations should be noted.

1. The arrangements for and manner of giving the examination should be such as to respect the modesty of the employee and not to arouse his antagonism.
2. The examination must, however, above all things be thorough. It is a waste of time and money to give the examination carelessly. It must cover the entire physical condition from head to foot.
3. Every question on the examination must be answered, not simply the defects noted. This is a protection to the company in the case of defects developed or discovered later.

Physical examinations are the means of doing a great deal of good to the employee through pointing out the necessity for the correction of defects. Of 15,000 men examined and found not normal, with conditions which should be corrected, 4115 had bad teeth, 1933 had bad eyes, 3243 had abnormal blood-pressure, 1714 had bad tonsils, 2416 had deformities in the extremities, 367 had bad chest conditions, 448 had ear trouble, 262 had kidney trouble, and 280 had heart defects.

Most of these defects were such as could be corrected. Most of the men did not know they had these defects, or else did not know until told by the examining physician, how comparatively easily they could be corrected.

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Molding Machines in the Foundry

By E. S. CARMAN

The beginnings of the art of making castings are shrouded in antiquity, but this much we do know, hand-labor made the first molds. Does it not shame us to think that hand-labor makes entirely too many of our molds today? Molding machines, however, have at last been devised. Coming at this stage in the world's advancement, the development of these machines will be more rapid than if the discovery had been made earlier. He who would stay abreast of the times in foundry matters must indeed be a busy man, for improvements will come by leaps and bounds, and the man that allows a single year's developments to be overlooked will be hopelessly outclassed.

We no longer walk, we ride, on the surface of the earth, underneath the surface, or up in the air, as suits our needs or fancy. We no longer laboriously copy a few books in a lifetime; the printing press performs that duty. Machinery performs our drudgery for us, with the exception of making molds. But here, as of old, the producer bends his back and tries to do work a machine should be doing. The motorman does not try to push the street-car, neither should the molder hand-ram the mold; the draftsman does not attempt to make a circle without compasses, neither should the molder attempt to draw a pattern by hand.

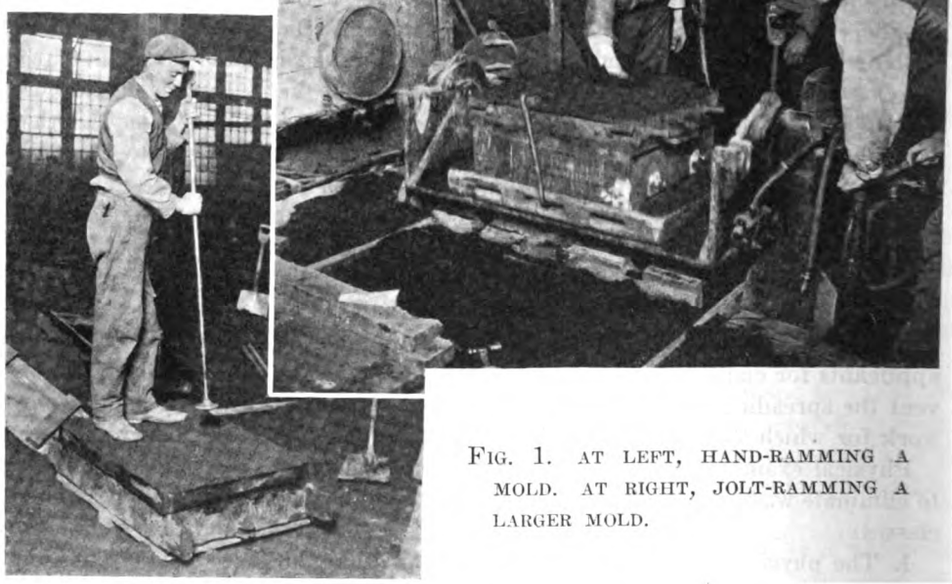

FIG. 1. AT LEFT, HAND-RAMMING A MOLD. AT RIGHT, JOLT-RAMMING A LARGER MOLD.

So much for generalities, now for detailed facts. The things that molding machines do are as follows: Ram the mold, roll the mold over, draw the pattern. Ramming the mold is accomplished by squeezing and jolting. Of these two operations, squeezing is much the older, and much the less perfect of the two. Patterns with vertical sides require ramming in addition to squeezing, as do also all patterns over an inch or so in height. So, while the squeezer machine has been on the market for some time, it eliminates only part of one operation, namely, ramming. The newer jolting machine will satisfactorily jolt any kind of mold, provided the machine has an adjustable length of stroke and compression so that the character of the blow may be adapted to the shape of the pattern and the nature of the sand used. Jolt-rammed molds are rammed to uniform density over the entire surface of the pattern. When the mold is poured, the gases enter the sand uniformly. Many castings, which even with the best of venting frequently become swelled and scabbed when hand rammed, come out smooth and true to pattern when jolt-rammed. Looking at the matter from another viewpoint, that of the molder, ramming by hand consumes approximately half the time required in making a mold. The machine eliminates this entirely, since the ramming time is reduced to less than 30 seconds. Also the back-breaking work of ramming is replaced by the simple operation of a lever.

The second operation that can be done by machine is the rolling over of drag-molds. The work of clamping is always done in the same position and on uniform-sized flasks and bottom-boards. This means that no time is lost in carrying clamps and wedges from one place on the floor to another and that the wedges always fit, since the flasks and bottom-boards have been standardized. Then the roll-over operation is performed by the machine, with no waiting for the crane, no summoning of other men from their jobs to help, no danger of the flask slipping on the bottom-board. The entire operation is performed almost instantly.

Lastly comes the pattern-draw, the stage in the making of molds where the molder operates to greatest disadvantage. A man who has handled heavy sand, carried heavy flasks, and in other ways exerted almost his maximum strength should not be expected to perform an operation requiring extreme sensitiveness and control in the fingers that have been hardened by heavy labor. A draftsman or a pianist would be better adapted to the delicate task of drawing the pattern. The machine ex-

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cels any human hand in accuracy of the draw. So great is the accuracy obtained with machines that patterns are constructed in which the draft is measured in thousandths of an inch. While on the subject of pattern-drawing, the question of rapping should not be overlooked. The 'gentle' blows of a two-pound hammer or of a lighter rapping-mallet enlarge the mold so much that the casting often weighs from 5% to 7% more than one made from the same pattern after it had been mounted on a machine. Allied with the subject of pattern-drawing is the question of slicking and patching, those highly skilled operations that consume so much time and cause so many defects in the casting. Of slicking and patching on machine-made molds, nothing need be said, for those operations are eliminated. Back-drafts or a defective machine are the only sources of broken molds, and in such cases the remedy is to be applied to the cause rather than to the mold itself.

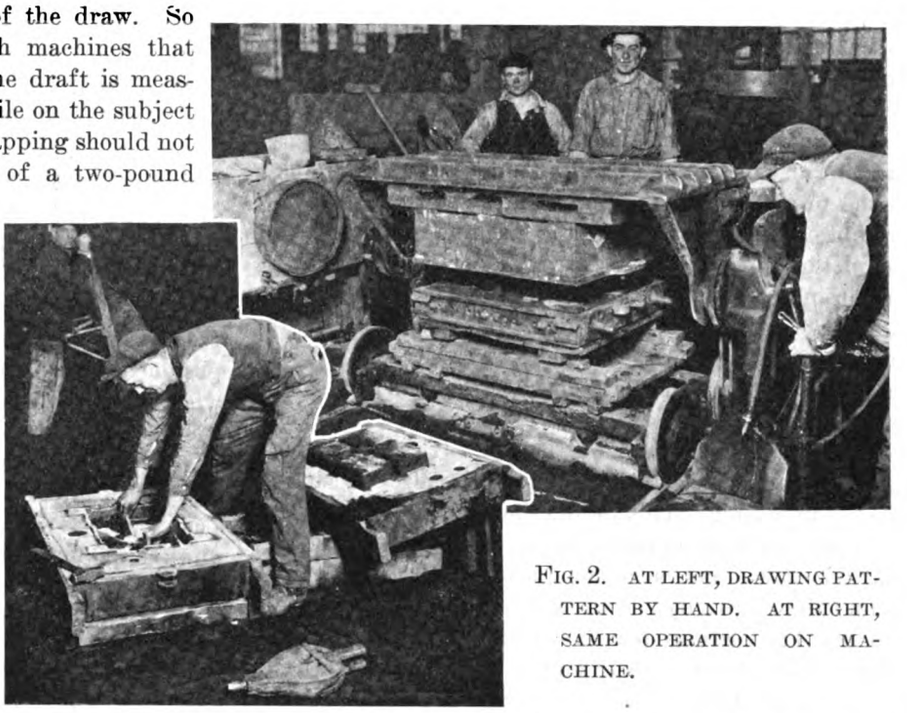

FIG. 2. AT LEFT, DRAWING PATTERN BY HAND. AT RIGHT, SAME OPERATION ON MACHINE.

What are the results obtained by using machines? What happens when hand-labor and skill are replaced by machine-labor and skill? The time required to make a mold is less, the labor required to make a mold is less, and the mold when made produces a better casting in less time, and with less labor. Surely these results are worth while, surely every foundryman should consider them. Foundrymen that adopt machines secure the following results: Better castings, which means that customers are better satisfied. More castings, which means more satisfied customers and greater returns on the money invested in the business. Less hard manual labor on the part of the molders, so that they stay fresh, do better work during the latter part of the day, and go home better satisfied.

FIG. 3. DRAWING PATTERN FOR PUMP-BASES

In Fig. 1 and 2 the old and new methods are contrasted. In Fig. 1 the molder at the left will be doing well if he completes the ramming of the mold shown in 30 minutes. The machine is shown jolt-ramming a larger mold, which requires approximately 30 seconds for jolting, including the time taken by the operator in stepping to the valve and opening it, as well as the actual time of ramming. In Fig. 2 the molder is shown attempting the impossible, namely, trying to draw the pattern exactly vertically, while the machine is doing what he can never hope to do; that is, draw the pattern without leaving the mold in such a condition that it will require slicking. The operator on the machine is evidently an old molder and has not outgrown the molder's habit of looking with much interest as soon as the pattern is drawn to find out how much damage he has done. New men 'broken in' to machine-molding do not get this habit. They become ac-

FIG. 4. CLOSING COPES FOR PUMP-BASES. FINISHED CASTING IN FOREGROUND

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customed to a perfect draw and it never occurs to them to be anxious about the outcome, but the old molder, familiar with the great amount of slicking and patching necessary in hand work, always looks anxiously as soon as he can to see how much damage has been done by the drawing of the pattern. Fig. 3 and 4 illustrate stages in the production of the pump-bases shown in the foreground of Fig. 4. In Fig. 3 the machine is shown at the completion of the pattern-drawing operation. In Fig. 4 the closing crew is setting a cope. Four men make, pour, and shake out 40 molds per day. Two men operate the machine making the drags, which contain the entire casting, and also ram the flat copes on the bench by hand, assisted by the laborer, who also helps close the molds. There is only one molder on the job. His duties are to set cores and inspect the molds. He also assists the laborer in closing. This production of 40 molds per day from one machine is below the average due to the fact that the crew is not large enough to operate the machine to its fullest capacity. A crew of eight men could easily produce 120 castings per day, thus increasing the castings per man from 10 to 15 and decreasing the overhead, due to the machine, to be charged to each casting. Under such conditions the rate at which the castings are desired is one of the determining factors.

The future foundry engineer, with machines at his disposal, may arrange his crew and his pattern and flask equipment, so that his methods will be as far superior to the ways of handling production as the lathe is to the file in producing a round shaft in the machine-shop.

A COLORED detachment under a white lieutenant was making its way through the shattered territory near Dun-sur-Meuse during the thick of the Argonne drive. At the cross-roads it encountered a traffic directing M. P. who halted the column.

"Sorry, sir," he said to the officer in charge. "You are not allowed up that road. We have information that it is about to be shelled by the enemy."

The officer carefully examined his orders. "My instructions read differently," he declared. "I cannot believe that this is the road to be shelled. Have you any verification?"

At this moment a shell burst within a hundred yards, tearing up the earth and sending debris flying in every direction. The entire landscape was obliterated, and a dead silence, broken only by the crash of falling stones, ensued. Then, out of a cloud of settling dust, arose one faint terrified voice:

"Fo' Gawd's sake, lootenant, please take de gemun's word fo' it!"—The Home Sector.

"THERE are some parts of your speech I find it difficult to understand," said a friend to a certain Senator, after the latter had spoken for nearly an hour.

"Point them out," was the reply, "and I'll rewrite the other parts. I intended the entire speech to be that way."—'Los Angeles Times'.

Stainless Steel

By a modification of the stainless or rustless steel hitherto used solely for knife-blades, a process has been developed at Sheffield, England, whereby rustless steel is now applied to the production of a variety of articles, including domestic cooking-utensils such as frying-pans, saucepans, and kettles.

Rustless steel differs from ordinary carbon-steel, which was formerly used for making knife-blades, in that it contains a large percentage of chromium. Chromium renders steel impervious to oxidation, which, with the presence of moisture, is the cause of rusting. It also, when highly polished, resists the corrosive action of acids, such as vinegar and orange-juice, and is not stained by vegetables. Up to a short time ago rustless steel was only used in the manufacture of table, dessert, and pocket-knives, because it was found difficult to harden and temper. Incidentally, it may be mentioned that this difficulty is being overcome.

To produce a stainless steel that could be worked comparatively easy and could be used in the manufacture of other articles became the task of metallurgists, and after many experiments they discovered the accurate heat treatment at which it became more workable, and the evolution of these new pots and pans has been the result. The production of this steel is being undertaken in large quantities, and rustless cooking dishes will soon appear on the market. These stainless domestic utensils will have a perpetual appearance of burnished steel no matter what usage they are put to. They may be cleaned by simply being washed in boiling water. They will not readily scale like iron, and therefore their bottoms will not get thin. Both time and money will be saved to the housewife.

The new rustless steel will also be invaluable to engineers and can be used for the manufacture of bolt heads and for similar purposes where resistance to corrosion is desired. Engineers are even inquiring into its use for structural purposes, such as for bridges, so as to eliminate the expense of painting.

At present manufacturers of rustless steel can sell it for 50 cents per pound, and this ensures that domestic cooking-vessels can be produced at a price that will enable them to compete with enameled, tin, and aluminum ware.

WE are grieved to note that ring-tailed cat fur has advanced in price 150% since last September and that Russian squirrels have risen 90%. We are unable to account for the rise in the ring-tailed commodity, but it may be that the extra hazard in extracting the squirrels from their nests in the whiskers of the bolsheviki has caused that advance.—Stockton Independent.

"IS THIS ALL you have got to eat?" the traveler asked dejectedly as he looked over the counter display in the railway lunchroom.

"Oh, I haven't got to eat it, thank goodness," the attendant responded earnestly. "I only have to sell it."—Home Sector.

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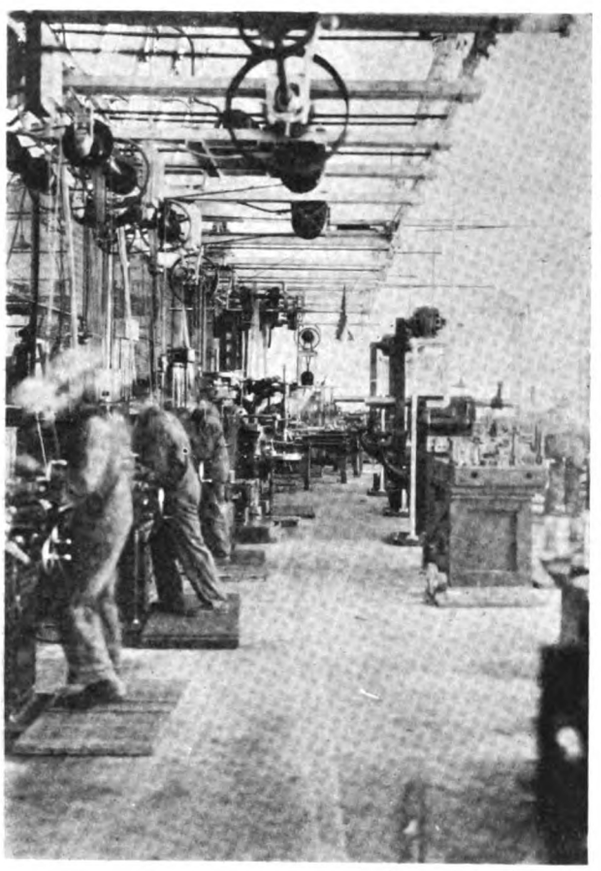
Toolroom of the Hall-Scott Motor Car Company

The Hall-Scott Motor Car Co. of Berkeley has recently moved and rearranged its toolroom as well as installed some additional equipment. The new toolroom extends along most of one side of the main machine-shop. The equipment of the toolroom proper comprises five grinders of various makes and types, three Brown & Sharpe milling machines, one Cincinnati Bickford radial drill, one Barnes drill, one Sigourney drill, one Stockbridge planer, one Gray planer, one Pratt & Whitney small bench-lathe,

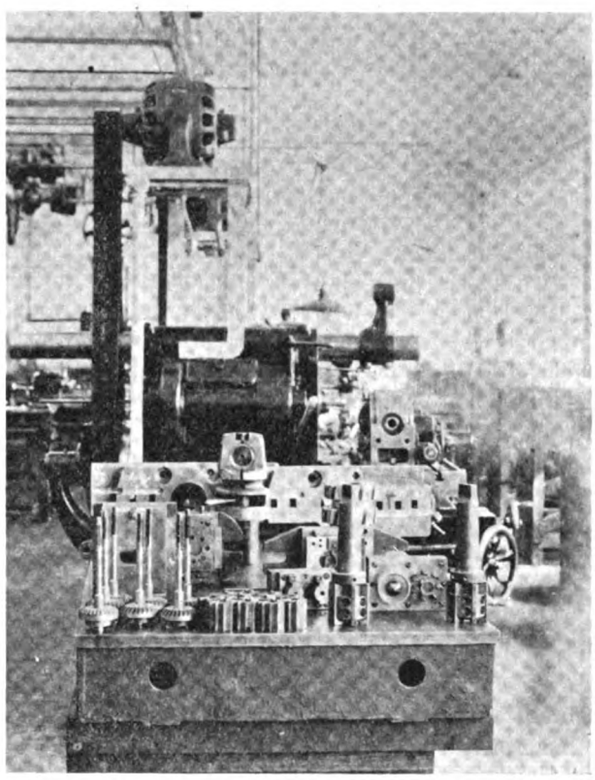


INTERIOR OF TOOLROOM PROPER

five other lathes of various types and makes, and a small Tate-Jones furnace for heat treating the minor tools. Tools above a certain size are treated in larger furnaces in the main heat-treating department. All machine-tools have individual motor-drive.

The tool, jig, and fixture storage department adjoins the toolroom proper. Each man upon starting to work in the manufacturing department is given ten or more checks bearing his payroll number for drawing tools, the number varying according to the class of work on which he is engaged. On drawing a tool he hands a check to the tool-keeper, who retains it until the tool is returned. Lost tools are charged to the man drawing them. Tools broken in service or otherwise defective must be returned to the toolroom in order that they may be credited properly. A liberal supply of small lathe-tools, taps, reamers, drills, etc., is kept in the toolroom, and those broken or worn out are entered regularly on a perpetual inventory form. When the stock of any particular article reaches a certain point, a work order or purchase order is made out, according to whether the article is to be made in the shop or bought on the outside.

Most of the company's product is of such a character that a special set of jigs and fixtures is required for each sequence of operations. All operations have been studied



SOME OF THE SPECIAL TOOLS, JIGS, AND FIXTURES MADE IN THE TOOL DEPARTMENT

and standardized, and special directions prepared. When a machinist receives an assignment, he also receives his instructions and a blue-print showing the work and the tools needed for the particular operation, bearing also a number in the lower right-hand corner. He goes to the tool-keeper and receives a box bearing that number and containing all the jigs and fixtures required for the particular set of operations. The boxes bear two sets of numbers, one corresponding to the operation, and the other set indicating the position on the racks. The former number is stamped in the wood, the latter is in raised aluminum letters. As the boxes are necessarily of many different shapes and sizes the arrangement on the racks is determined by convenience in storage. Thus box No.

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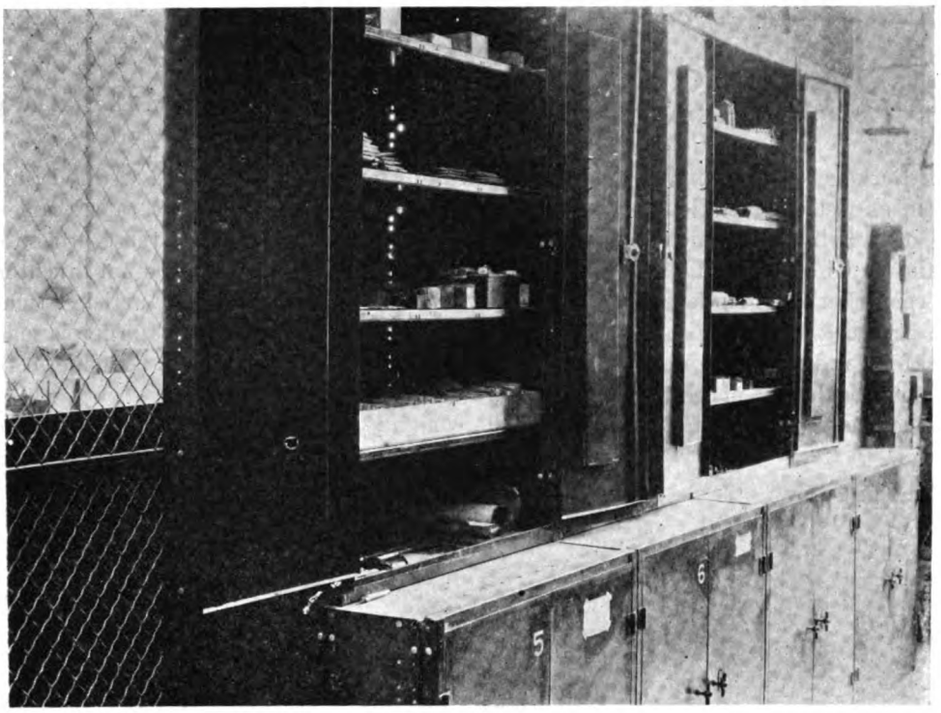


LOCKERS FOR STORAGE OF SMALL TOOLS AND SUPPLIES

21-1 goes on the extreme left-hand side of rack No. 21 and box No. 21-2 stands next to it, but one may be stamped 2441, corresponding to the drawing bearing that number, and the other 893. However, the tool-keeper's cross-index makes it possible to find the box for any drawing without delay. The number of boxes on any particular rack varies with the size of the box.

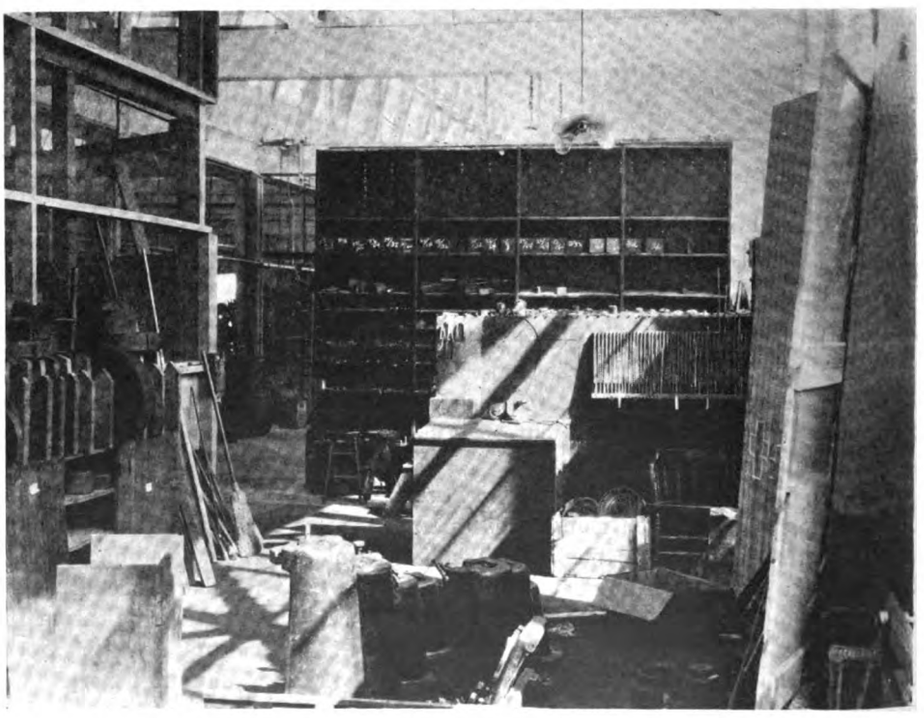
When a man completes the work shown on a given drawing he returns the box to the tool-keeper and receives his check. The tool-keeper checks the contents of the box against the drawing and also inspects the contents. If any tool or fixture requires attention he sends it into the toolroom for sharpening or repairs, noting this on his records so that he can tell at any time, not only what boxes are in the shop, but also what boxes on the racks are incompletely filled because of their regular contents being in the toolroom.

Sharpening of tools in the main shop is not allowed, all this work being done in the toolroom. A sufficient stock of tools is maintained so that when a tool becomes dull or otherwise unfit for use, it is replaced with a fresh tool and the work proceeds without delay. The grinders are equipped to grind any desired angle in all three dimensions. In the toolroom are also made the many special tools, dies, jigs, and fixtures used by the company in its work.

The company has two sets of Johannson gauge-blocks, one for the inspection department and one for the toolroom. All gauges are checked with these every three months, or oftener if for special reasons it appears necessary. The Johannson blocks are used regularly in the toolroom in the construction of gauges and for other work requiring precision. The practice of spending several hundred dollars for standards and then locking them up to protect them from the profane hand of the workman is not followed at the Hall-Scott plant.

Acknowledgment should be made to W. Hartung, foreman of the toolroom, for assistance in preparing this article.

If the optimists who still carry corkscrews in their hip-pockets need any cheer and encouragement, we would call their attention to the news item that direct steamship service between San Francisco and Havana will start May 8. No, we don't know what the fare will be.



PART OF TOOL-STORAGE DEPARTMENT

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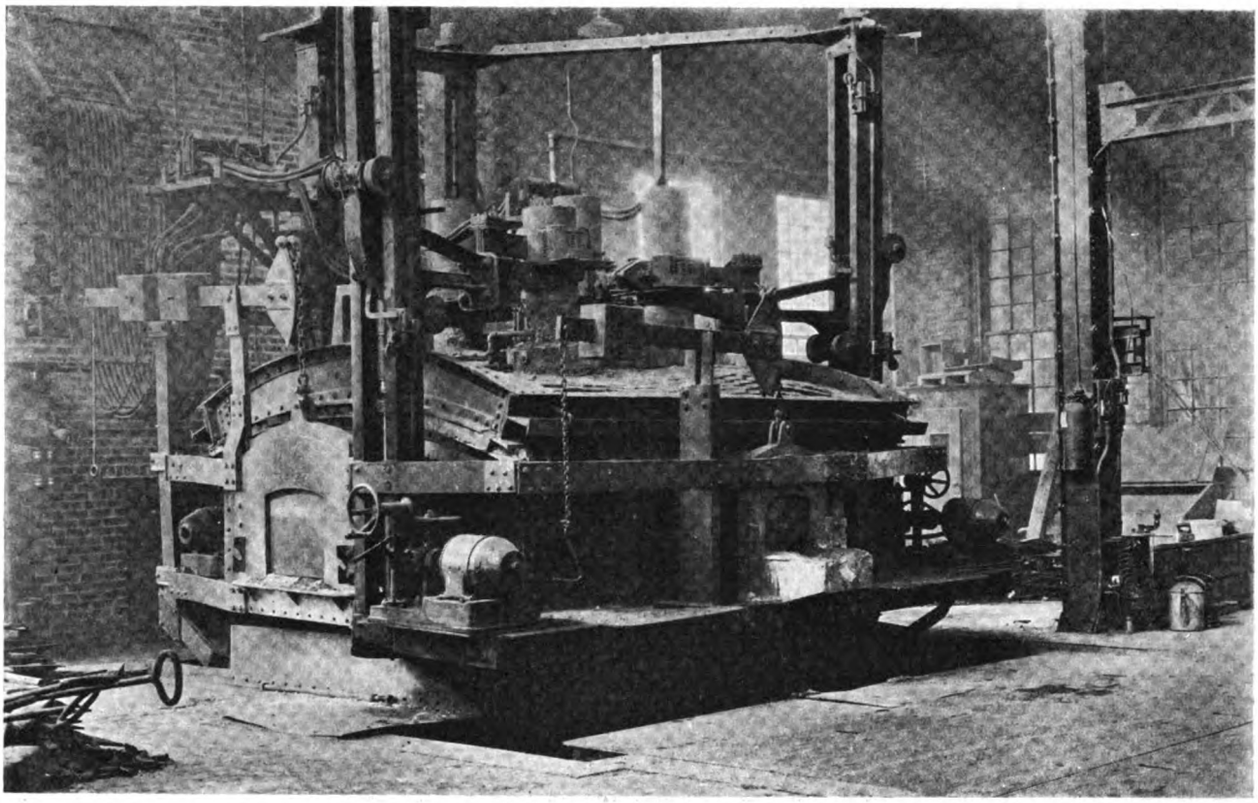

THE GREAVES-ETCHELLS FURNACE AT THE MARE ISLAND NAVY YARD

Electric Furnace Practice on the Pacific Coast—II*

The Greaves-Etchells Furnace

The Greaves-Etchells furnace was developed about 1915 by two English engineers. It is handled in the United States by the Electric Furnace Construction Co., of Philadelphia. Figures compiled recently by the company show 73 furnaces in various parts of the world, ranging in capacity from ½ to 15 tons, and with a total capacity of about 160 tons. Of this number, 38 furnaces are in Great Britain, and 17 in the United States. On the Pacific Coast at the present time there are two furnaces of this type, one at the Puget Sound Navy Yard and one at the Mare Island Navy Yard. Both of these are 6-ton furnaces.

The most important characteristic of the Greaves-Etchells furnace lies in the method of application of the heat. Two phases of a three-phase low-tension supply are connected to their respective electrodes, while the third phase is connected to the bottom of the hearth. An out-of-balance load is prevented by the system of transformer ratios. This, it is claimed, gives more uniform heating than where all the heat comes into the furnace from the top. Special methods of dealing with short-circuiting of electrodes have been developed as follows:

The system of transformer connections is arranged so that the short-circuit current of one electrode must traverse two transformers in series and in different phase, which automatically lowers the power factor and has a strong buffer effect. The bad effects of short circuits on the load are also limited by the fact that there is a permanent resistance to the part of the current through the hearth.

The supply of energy to the furnace is regulated over a considerable range by raising or lowering the electrodes. This can be done either automatically or by hand. Equipment is also provided for varying the voltages across the arcs, giving a high voltage during the melting-period and a low voltage during refining.

The hearth is 20 in. or more thick and is built up with dolomite or magnesite. The electrical resistance is high at the inside of the bath in proximity to the charge and decreases to a negligible quantity at the outside.

As already stated, the furnace at the Mare Island Navy Yard is at present the only one of the Greaves-Etchells type operating in California. This furnace was placed in operation during 1919. Prior to this time, all steel castings made at the Navy Yard were poured from a converter, but this has been discontinued entirely since

*The first article of this series, on the Heroult furnace, appeared in 'Metal Trades' for June 1919.

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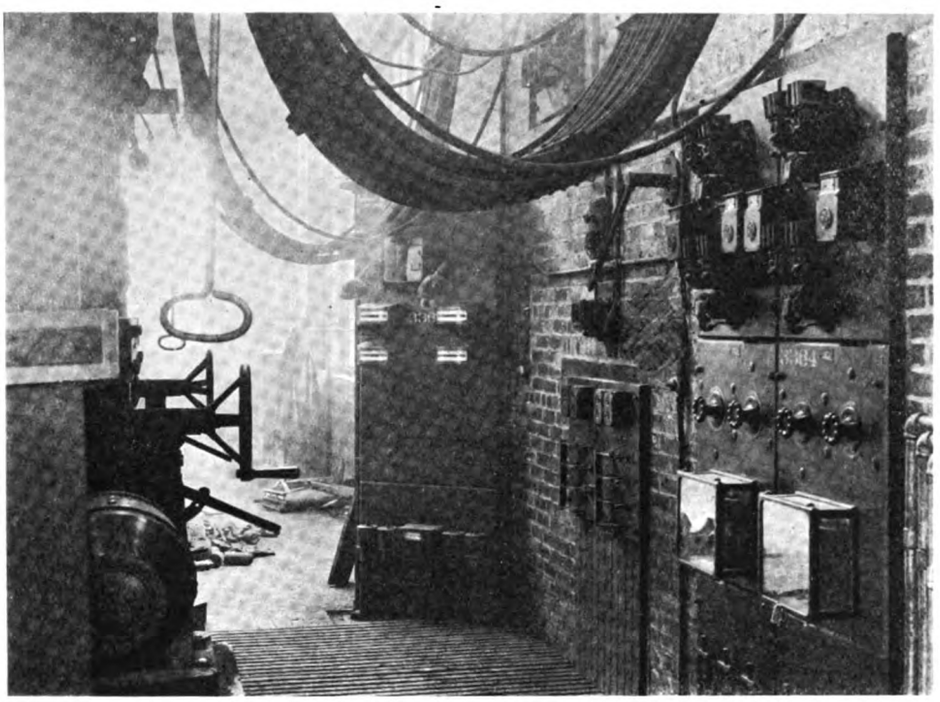
the Greaves-Etchells furnace was completed. Small steel castings of all kinds used at the Navy Yard are made, and no difficulty is experienced in holding the analysis to conform to Navy specifications. So far, the policy of the Department has been to purchase most of the larger castings required, although it is the belief of those operating the furnace that these castings as well could be produced as cheap or cheaper than they can be bought from outside firms. The result of this limitation of the field of the furnace is that there is seldom more than enough work for one heat per day, and frequently only two or three heats are poured per week. The furnace has a basic lining.

Although the furnace is of six tons nominal capacity, heats ranging from three to eight and a half tons have been poured, and it is believed that as much as ten tons could be poured with a little special preparation of the furnace beforehand. Cold scrap is used exclusively as the basis for the charge, most of the scrap being obtained from various operations at the Navy Yard. The melting loss varies with the character of the scrap charged, but has never exceeded 5%, even though a good deal of light scrap is used.



REAR OF FURNACE SHOWING SWITCHBOARD AND CONTROLS

Starting with a cold or nearly cold furnace, about five hours is required for the first heat. This is assuming that the regular process of two slags, the first oxidizing and the second deoxidizing, is followed.

The scrap is charged and the power turned on, the controls being arranged so that the load can be turned on gradually. Power is obtained from the Pacific Gas & Electric Co. and is supplied at 2300 volts, with a 60-cycle 3-phase current. The transformer-house is placed directly back of the furnace and the current comes to the furnace at 100 volts. As will be seen from the accompanying photograph, there are four electrodes, two on each side. Carbon electrodes are used. The total power required for the furnace is 1500 kva. The amperage is 5500.

About the time the scrap begins to soften, the first flux is added, comprising, for a 6-ton charge, about 240 lb. of lime and 40 lb. of fluorspar. This, as already noted, is an oxidizing slag, and no further additions are made until after this slag has been removed. The silicon, phosphorus, manganese, and carbon are gradually burnt out of the iron and taken up by the flux, which turns black. Until the carbon, which is the last of these elements to be oxidized, has been practically removed, the slag will be pasty. The proper time for the removal of the first slag and the addition of the second can also be checked by taking a sample of the metal and making a quick analysis. The first slag can usually be poured off about four hours after starting the furnace.

After the oxidizing slag has been removed, a second and deoxidizing slag is added composed of lime and fluorspar as before, together with carbon usually in the form of broken electrodes. Additions of 80% ferro-manganese and 60% ferro-silicon in the proper amounts to give the desired analysis for the finished steel are also made. This slag should have a cream or 'cigar-ash' color, and great care must be taken by the melter to prevent the slag turning black, as this indicates that the calcium sulphide carried in the slag is being precipitated back into the steel. The second slag is not poured off, but is tapped with the metal and remain on top of the ladle, protecting the metal from oxidation. The use of a bottom-pouring ladle makes this possible without carrying the slag into the molds. The voltage is lowered at the time the second slag is added and remains low during the refining period. Further to ensure deoxidation, a little aluminum is added to the charge during the refining period.

Besides small castings, a number of 18-in. forging-ingots have been poured, with good results. It is necessary to crop off about 15% from the top of the ingot and 5% from the bottom, the remainder being sound. The crop-ends are re-charged as scrap.

The hearth of the furnace is so arranged that all the metal can be poured from it. Slag that is sticking to the walls is 'sponged up' with refractory material. After pouring, the hearth is patched with refractories where necessary. After about 75 heats, it was found necessary to put on a new top to the furnace, a comparatively simple operation, since the top is lifted off with a crane

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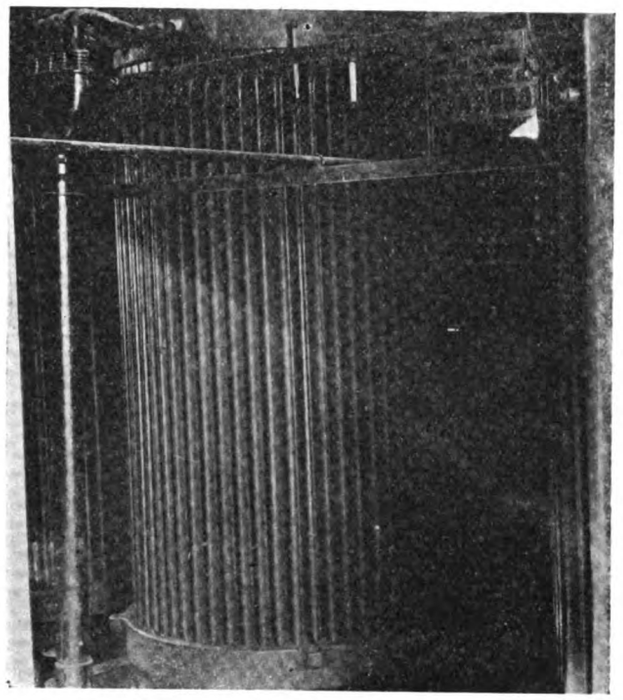
and a new one set in its place. It is advisable to have an extra top ready in order to avoid delay when the old top wears out. So far, renewal of the hearth has not been necessary.

For operation of the furnace proper, the following crew is required: one foreman, one melter, one furnaceman, one ladle-man, and two helpers, six men in all. For a six-ton heat about 40 lb. of electrodes is consumed. The consumption of energy per ton of steel produced has



INTERIOR OF TRANSFORMER-HOUSE

averaged around 1000 kw-hr. It should, however, be remembered that the necessarily intermittent operation of the furnace prevents the maximum economy being obtained. It is believed that with continuous operation, this consumption could be reduced to 600 to 700 kw-hr. per ton.

One feature of the Mare Island installation that was particularly important because of local conditions was the provision of a cooling system for the circulating water. The water is pumped to a tank outside the foundry building. In a place where water was cheap and plentiful, such a system might not pay for the cost of installation, but at Mare Island, where neither of these conditions exist, a net saving of about $600 per month was obtained.

Temperature readings of the transformers are taken once a day. This temperature should not exceed 70°C. If it does, the load is reduced temporarily and all the building-ventilators opened.

Two popular present-day amusements correspond accurately to our idea of nothing to do. The first is to hold a wet-and-dry election and the second is to buy bonds of the Irish republic. Further nominations are in order.

Making Hand-Forged Tools for Special Purposes

At the other end of the scale from the quantity production of the Ford Motor Co. and similar organizations stands the concern that makes a limited quantity of equipment for special uses and which relies on quality to compensate for the relatively high prices that such methods of production necessitate. A firm of this latter kind is the Gogle Hand-Forged Tool Co. of San Francisco, which makes small tools of a great many kinds for automobile, aeroplane, wood-carving, and other special work. All of the work is done under the personal supervision of Mr. Gogle, and with the exception of a few of the larger tools, each one is hammered and shaped by hand.

Among the automobile tools made are bearing scrapers, both hollow-forged and flat, and tools for making oil-grooves. Of special interest are socket wrenches made by welding chrome-nickel steel wrist-pins for the socket to machinery-steel handles. The welding is done in an ordinary forge-fire, common sand from the backyard of the shop being the only flux required.

Of particular interest among the company's products are its tools for making artificial limbs. Willow wood is employed for making artificial limbs, and they are scraped as thin as possible. For shaping them in curves corresponding to the muscles of the body, special scraping tools of a high degree of workmanship are required. Tools made by the Gogle company are used by artificial-limb makers all over the United States.

The company's aeroplane wrenches require special care in their manufacture, since all tools for this class of work must be made as thin as possible consistent with strength. Other interesting tools include jewelers' hammers and a special instrument resembling a pair of pliers used by hairdressers for producing the 'permanent wave' so much in demand among the ladies.

A FRENCHMAN, guest at a London hotel, had just been presented with his bill. Though he paid it without formal protest, he was most indignant at its amount.

"I weesh to zee ze proprietaire!" he exclaimed to the clerk.

In a moment the proprietor entered. The Frenchman was all smiles.

"Ah!" he exclaimed, "I must embrace you!"

"But why should you wish to embrace me, sir?" asked the astonished hotel keeper. "I do not understand."

"Look at zees bill!"

"Yes, your receipted bill. What of it?"

"What of it? Seemply zees, saire, it means zat I shall nevaire, no nevaire, meet you again."

TENURE of office of a President of the German republic seems to be about as uncertain as that of an American Secretary of State.

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Employment Department of the Hall-Scott Motor Car Company

The Hall-Scott Motor Car Co. of Berkeley manufactures principally aeroplane, marine, and other high-grade internal-combustion engines. During the War the factory was entirely given over to war work of various kinds, as many as 600 men being employed. With the completion of war orders soon after the Armistice, the working force was reduced considerably, but the management had already entered on an aggressive campaign for 'peace business', as a result of which the number of employees was gradually increased until at the present time over 300 men are on the payroll. Nevertheless, in spite of disturbed labor conditions during the past year or so, production has not been allowed to suffer because of lack of competent workmen. The success of the company's employment system appears to lie mainly in the fact that

H.-S. M. C. CO. FORM 102

LABOR ORDER BLANK

To Employment Department: USE SEPARATE BLANK FOR EACH EMPLOYEE REQUIRED

Please employ for this department one.....

To work on Machine No..... Kind of machine..... as { Operator / Helper

Date needed..... 19..... Total number required.....

Experience required.....

Approved by.....
(Division Head).....
(Title).....

Signed:..... Foreman
Dept. No.....
Dated..... 19....

To Foreman:
We have filled the above order by employment of Mr.....
at rate of..... Pay Roll No..... Application No..... His previous experience has been.....

Date..... 19.... Signed:..... Employment Manager.

FIG. 1. BLANKS USED BY FOREMEN IN MAKING REQUISITIONS FOR MEN

a man is paid what he is worth and is advanced as his value to the company increases.

The employment department is in charge of P. S. Williams, employment manager. When a foreman requires additional help he fills out the upper half of the 'Labor Order Blank' shown in Fig. 1, which is also approved by the division head. Foremen are encouraged to anticipate their wants as much as possible, but there is no set rule about this point. This blank is made out in triplicate and sent to the employment manager, who tries to fill the position either from application cards already on file, or from the daily run of applicants coming to his office. A workman seeking employment fills out the application shown in Fig. 2. If he worked for the company before, his former record is on file and can be consulted to determine the advisability of hiring him again. When a man is selected by the employment manager for a given job, the latter fills out the lower part of the 'Labor Order Blank' and sends the applicant to the foreman for final interview. If satisfactory to the foreman he is hired and is issued a temporary pass good for not more than five days from date of issue, which permits him to enter the plant until a regular photographic pass can be prepared. This latter pass is made out in duplicate and has the man's photograph, name, payroll num-

H.-S. M. C. CO. FORM 100

(Employee No.....)

APPLICATION FOR EMPLOYMENT No.....

For employment as.....

Name..... Phone.....

Address .....

Present occupation .....

Experience .....

Age..... When born.....

Where born..... Naturalized / American

EDUCATION					HAVE OWN TOOLS		USE MICROMETER		
TECH.	UNIV.	HIGH	COM. G	APPR.	YES	NO	YES	NO	OWN ONE

MARRIED / SINGLE | Wife's name.....

Number children..... Number under 16 years of age.....

Other dependents .....

Ever employed by Hall-Scott..... What year..... No.....

(Signed).....

Date..... 19.....

(Application will only be kept on file for a period of six months.)

Employment Manager's Memo.

(Signed).....

APPLICANT'S REFERENCES	Berkeley, Calif., 19	
Employer	Employed	Reference Requested
Address	Date left	
City State	Position	Reply Received
Foreman	Number	
Employer	Employed	Reference Requested
Address	Date left	
City State	Position	Reply Received
Foreman	Number	
Employer	Employed	Reference Requested
Address	Date left	
City State	Position	Reply Received
Foreman	Number	

I hereby release from all liability or damage of whatsoever nature, any individual or corporation who furnishes information to the Hall Scott Motor Co. that is to be used by them in determining my fitness for a position with them, and have signed their "Application for Employment" with a knowledge that the individuals or corporations whom I have given for reference will be requested to submit a report covering my competency and conduct while in their employ.

Witness: Signed:

FIG. 2. APPLICATION FORM (BOTH SIDES)

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ber, etc., upon it. One copy goes to the files and the other, together with a brass check bearing his payroll number, to the workman.

As already noted, the 'Labor Order Blank' is made

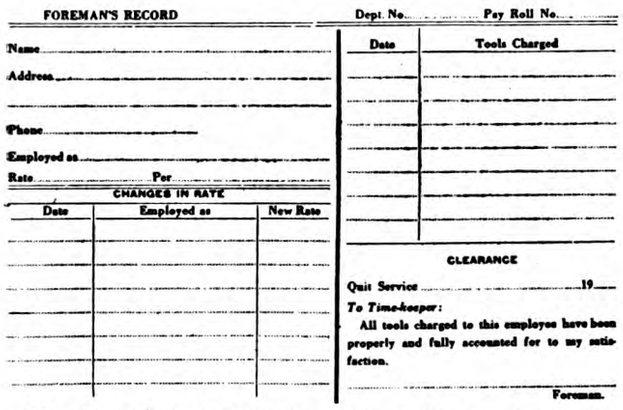
FOREMAN'S RECORD Dept. No. Pay Roll No.
Name
Address
Phone
Employed as
Rate Per
CHANGES IN RATE
Date | Employed as | New Rate
Date | Tools Charged
CLEARANCE
Quit Service 19
To Time-keeper:
All tools charged to this employee have been properly and fully accounted for to my satisfaction.
Foreman.

FIG. 3. REVERSE SIDE OF LABOR ORDER BLANK USED FOR FOREMAN'S RECORD

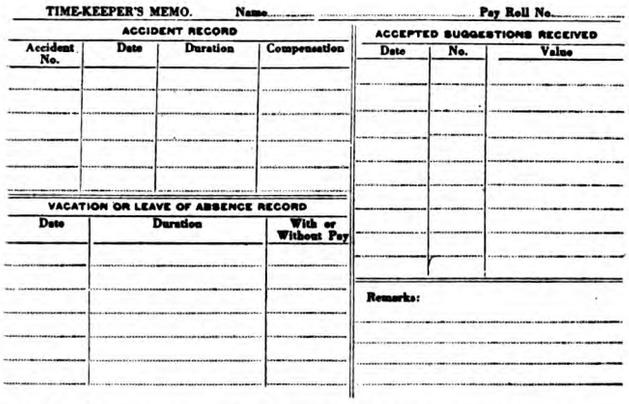
TIME-KEEPER'S MEMO. Name Pay Roll No.
ACCIDENT RECORD
Accident No. | Date | Duration | Compensation
ACCEPTED SUGGESTIONS RECEIVED
Date | No. | Value
VACATION OR LEAVE OF ABSENCE RECORD
Date | Duration | With or Without Pay
Remarks:

FIG. 4. REVERSE SIDE OF LABOR ORDER BLANK SENT TO TIMEKEEPER

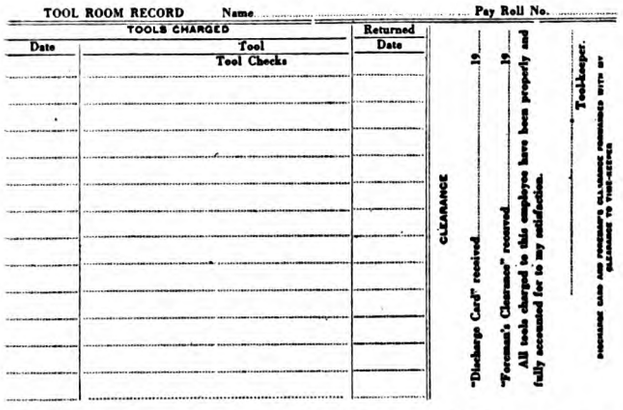
TOOL ROOM RECORD Name Pay Roll No.
TOOLS CHARGED
Date | Tool | Tool Checks
Returned Date
CLEARANCE
"Discharge Card" received 19
"Foreman's Clearance" received 19
All tools charged to this employee have been properly and fully accounted for to my satisfaction.
Toolkeeper.

FIG. 5. REVERSE SIDE OF LABOR ORDER BLANK SENT TO TOOLROOM

out in triplicate. On the reverse side of one copy is the 'Foreman's Record' shown in Fig. 3. The reverse side of the second copy, which goes to the timekeeper, is shown in Fig. 4, while the third copy, which goes to the toolroom is shown in Fig. 5. The three copies are printed on different-colored paper.

About a year ago certain definite changes were made in the labor policy of the company, the most important being the establishment of an open shop and of a minimum wage of $6 per day for all regular employees. Skilled mechanics upon commencing work are paid the union scale and are advanced according to ability. Unskilled workers in all departments are paid $4 per day for a probationary period of three months, during which time each man is instructed in his work and an endeavor is made to fit him to the work best suited for him. At the present time the foremen are responsible entirely for training the probationers, but plans are now being considered for the establishment of a separate training department. At the end of the three months period, if the man's work is reported unsatisfactory by the foreman under whom he has worked, he is discharged, it being assumed that three months is a sufficient time to demonstrate whether or not he is fitted to work for the company. Discharges for cause can, of course, be made at any time.

On the other hand, if the foreman's report at the end of three months is favorable, the employee is advanced

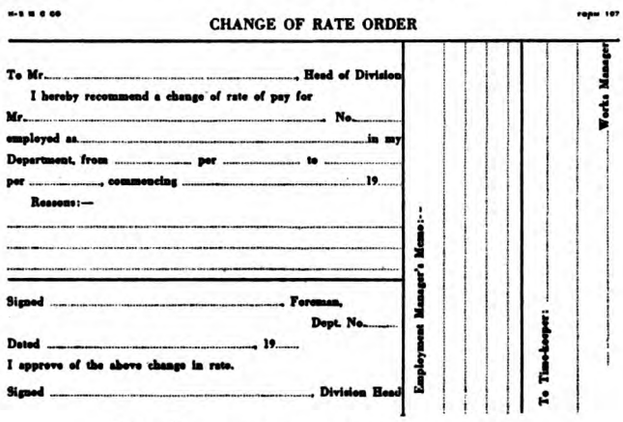
CHANGE OF RATE ORDER
To Mr. , Head of Division
I hereby recommend a change of rate of pay for
Mr. No.
employed as in my
Department, from per to
per , commencing 19
Reasons:—
Signed , Foreman,
Dept. No.
Dated , 19
I approve of the above change in rate.
Signed , Division Head
Employment Manager's Memo:—
To Time-keeper:
Works Manager

FIG. 6. ORDER FOR CHANGE OF RATE

to $6 per day, and is advanced further when his work justifies it. When a man wants an increase he talks to his foreman about it, and, if his foreman approves the change, the latter makes out the 'Change of Rate Order' shown in Fig. 6. This form, after approval by the division head, employment manager, and works manager, goes to the timekeeper for his records. To guard against granting increased pay only to the 'kickers', the employment manager or his assistant go over with the foremen, the records of all the men in each foreman's department at least every six months, and recommend increases for the men that appear to deserve them, the same procedure being followed as described above. At the present time, many of the skilled mechanics are receiving $7.52 per day or better.

When a man desires a transfer to some other department, he goes to his foreman. If his foreman approves the transfer, the 'Employment Transfer Order' shown in Fig. 7 is started on its way, receiving, in turn, the approval of old foreman, old division head, employment manager, new foreman, new division head, and works manager. Like the original labor order blank, the form

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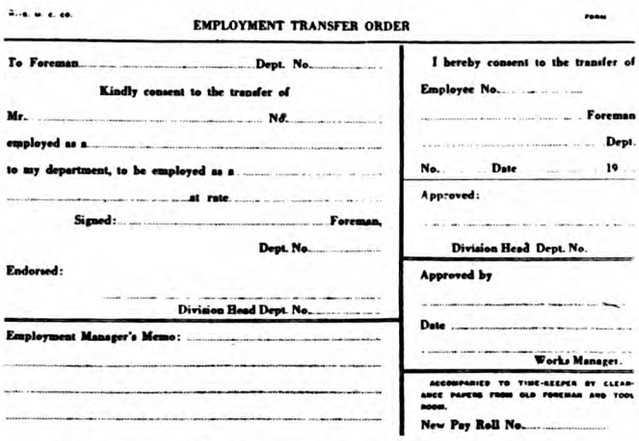
is made in triplicate, one copy for the foreman's record, one for the tool-room record, and one for the timekeeper. The reverse side of the three copies is the same as the reverse side of the copies of the labor order blank, shown in Fig. 3, 4, and 5. The man is assigned a new payroll number and the general procedure, as far as records are



EMPLOYMENT TRANSFER ORDER

To Foreman..... Dept. No.....

Kindly consent to the transfer of

Mr. ..... No.....

employed as a.....

to my department, to be employed as a.....

.....at rate.....

Signed:..... Foreman,

Dept. No.....

Endorsed:

.....

Division Head Dept. No.....

Employment Manager's Memo: .....

I hereby consent to the transfer of

Employee No.....

.....Foreman

.....Dept.

No. Date 19

Approved:

.....

Division Head Dept. No.

Approved by

.....

Date .....

.....

Works Manager.

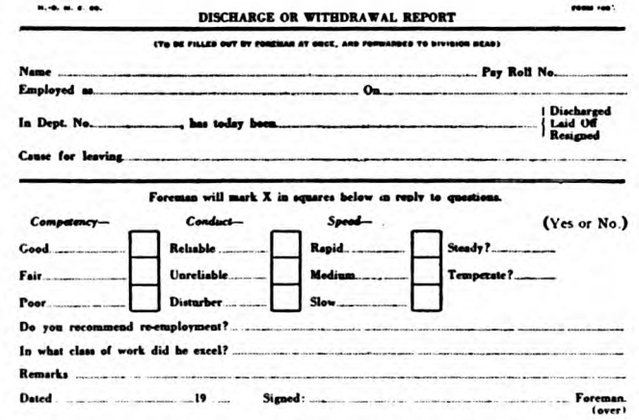
ACCOMPANIED TO TIME-KEEPER BY CLEARANCE PAPERS FROM OLD FOREMAN AND TOOL ROOM.

New Pay Roll No.....

FIG. 7. FORM FOR TRANSFERS. THIS IS MADE IN TRIPLICATE. THE REVERSE SIDES OF THE THREE COPIES ARE THE SAME AS FIG. 3, 4, AND 5

concerned, is the same as if he had left the employ of the company and had been re-hired.

When a man terminates employment for whatever reason, the foreman makes out the cards shown in Fig. 8 and 9. The card shown in Fig. 8 is sent to the division head. Spaces are provided on the reverse side of the card for reports in turn by the division head and the employment manager and for an authorization by the works



DISCHARGE OR WITHDRAWAL REPORT

(TO BE FILLED OUT BY FOREMAN AT ONCE, AND FORWARDED TO DIVISION HEAD)

Name ..... Pay Roll No.....

Employed as..... On.....

In Dept. No....., has today been..... | Discharged | Laid Off | Resigned

Cause for leaving.....

Foreman will mark X in squares below in reply to questions.

Competency—		Conduct—		Speed—		(Yes or No.)
Good		Reliable		Rapid		Steady?.....
Fair		Unreliable		Medium		Temperate?.....
Poor		Disturber		Slow		

Do you recommend re-employment?.....

In what class of work did he excel?.....

Remarks .....

Dated ..... 19 .... Signed: ..... Foreman.

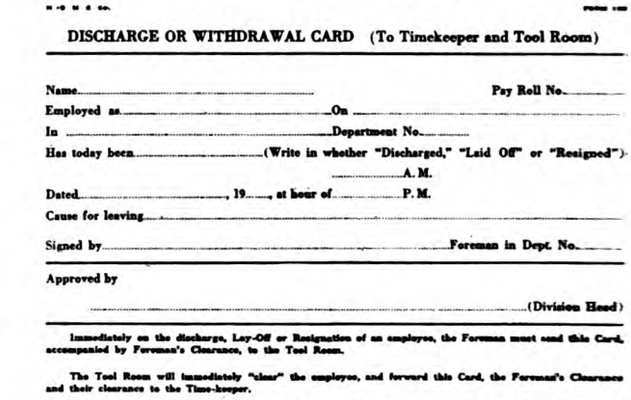
(over)

FIG. 8. DISCHARGE FORM (REVERSE SIDE NOT SHOWN)

manager to the timekeeper. The foreman sends the card shown in Fig. 9, together with the 'Foreman's Record' shown in Fig. 3 duly signed, to the tool-room. The workman returns tools taken from the tool-room, and the toolkeeper signs the Tool Room Record clearance, and sends the three cards to the timekeeper, who is then in a position to pay off the workman. The employment manager interviews workmen as to their reason for leaving and if the trouble appears to be inadequate pay or some other remediable cause, an endeavor is made to straighten out matters. The workman returns his pass and brass payroll check and receives his money.

With the exception of foremen and office employees, payment is made on Monday for all work up to and including the preceding Friday. The others are paid twice a month. When a man quits, his payroll number is 'dead' as far as that week is concerned, but may be assigned to a new man on the following Saturday or any time thereafter. Payroll numbers 1 to 150 are used for the machine-shop department, and a similar sequence of numbers for the other departments, so that a man's number indicates the department in which he works, but nothing further.

All the forms shown are uniform in size, 4 by 6 in. For the files of the employment department, an envelope, open at the top, and just large enough to hold all the records pertaining to one man, is used. On the outside of this envelope are spaces for entering the employee's name, address, application number, payroll number, tele-



DISCHARGE OR WITHDRAWAL CARD (To Timekeeper and Tool Room)

Name..... Pay Roll No.....

Employed as..... On .....

In .....Department No.....

Has today been.....(Write in whether "Discharged," "Laid Off" or "Resigned")

.....A. M.

Dated....., 19....., at hour of.....P. M.

Cause for leaving.....

Signed by.....Foreman in Dept. No.....

Approved by

.....(Division Head)

Immediately on the discharge, Lay-Off or Resignation of an employee, the Foreman must send this Card, accompanied by Foreman's Clearance, to the Tool Room.

The Tool Room will immediately "clear" the employee, and forward this Card, the Foreman's Clearance and their clearance to the Time-keeper.

FIG. 9. DISCHARGE AND CLEARANCE FORM

phone number, position and department in factory, and transfers, also the name, address, and telephone number of the person to notify in case of accident. Two files are kept, one for present, and one for former employees. This method permits quick reference to records in either file.

A VISITOR, green about army life, walked interestedly to the soldier who was digging a hole.

"Digging a trench, my good man?"

"No," smiled the soldier, sadly, "I'm digging a grave. One of our rookies just passed away. We were on the rifle-range and the Captain told us to hold our breath while pulling the trigger on the rifle. The lad's rifle was old and rusty, and the trigger stuck, and there you have it."—American Legion Weekly.

A CERTAIN CONGRESSMAN sent a number of eulogies on dead fellow-members to a constituent and received a warm letter of thanks for his trouble.

"Send me all of these eulogies that you can get," the correspondent wrote. "I'm always glad to hear of another dead Congressman."

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Labor Audit as Applied to a Manufacturing Plant

While the business world has long been accustomed to the sales audit, the financial audit, and even to the report on production methods within the plant, the idea that similar methods might be applied to the study of the human factors affecting production is comparatively new. With the increase of attention paid to the personnel problems and the establishment of employment departments in many plants, some managers have seen the advantages of a labor audit, or reasonably exhaustive and systematic statement and analysis of the facts and forces in an industrial organization affecting relations between employees and management, and between employees and their work; followed by recommendations as to ways of making the organization more socially and humanly productive and solvent. The Federal Board of Vocational Education has issued a bulletin on 'The Labor Audit', by Ordway Teed, upon which most of this article is based.

A labor audit is a statement and analysis of the facts and forces affecting relations between employees and the management, and between employees and their work, together with recommendations for improvement.

In general, an audit can be made with useful practical results wherever low production is the result of human rather than mechanical causes. The audit may be used to inquire into the causes of strikes and the reasons for the discontent among workers that has not yet come to a head in a strike. It may also be used to inquire into the causes of labor unrest. It may be used to study the causes of labor turnover.

The average manager or owner might reply that the causes of such difficulties in any particular plant can usually be discovered without going into such an exhaustive investigation. This may be true, but there are still many advantages to be derived from a complete examination, for reasons similar to those that impel an up-to-date physician to make a complete physical examination of his patient before attempting a diagnosis. An itemized standard list, which may be used as a guide in the work, makes omissions of important points improbable, permits comparison with other plants, and facilitates the repetition of the audit at some future time. Such a standard list is given below:

1. Physical working conditions.
   - A. Fire hazards.
   - B. Accident hazards.
   - C. Ventilation and heating.
   - D. Lighting.
   - E. Cleaning and drinking-water.
   - F. Sanitary equipment.
   - G. Seating and rest-rooms.
   - H. Dressing-rooms.
   - I. Noise and vibration.
   - J. Health equipment, hospital, etc.
   - K. Factory exterior.
2. Labor turnover.
3. Work and job analysis.
4. Sources of labor supply.
5. Methods of selection.
6. Methods of starting at work.
7. Training.
   - A. Job instruction.
   - B. Foreman instruction.
   - C. English instruction.
   - D. Inspection.
   - E. Transfer.
   - F. Promotion.
   - G. Grievances.
   - H. Shop-control.
   - I. Discharge.
   - J. Suggestion systems.
   - K. Relations to public schools.
8. Economic beliefs.
9. Employers' associations.
10. Employees' associations.
11. Trade-unions.
12. Joint relations.
13. Labor legislation.
14. Court decisions.
15. Labor-law administration.
16. Community relations.
17. Form and efficiency of management.
   - A. Production.
   - B. Sales.
   - C. Finance.
   - D. Personnel.
   - E. Co-ordination of staff departments.
18. Amounts and methods of pay.
19. Other provisions for employees.
   - A. Accident compensation.
   - B. Sickness insurance.
   - C. Unemployment insurance.
   - D. Pensions.
   - E. Life insurance.
   - F. Savings facilities.
   - G. Purchasing.
   - H. Housing.
   - I. Transportation.
   - J. Public health.
   - K. Recreational facilities.
   - L. Educational facilities.

Because of the nature of the facts covered by a labor audit, it is not possible to submit all its items to accurate measurement. All the subtle influences at work in the labor situation cannot be recorded in charts and figures. In fact, that is not what is needed or wanted, but rather a reasonably complete check-list to guide the investigator, so that his conclusions are kept in close relation to a defined group of facts.

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Usually, an important result of a well-prepared labor audit is the awakening of the management to the need of a more progressive labor policy. Frequently, in places having no organized employment department, one has been established as a result of the taking of a labor audit. In this connection it is useful to distinguish between facts that show an accepted policy is not being followed, and facts that indicate the need of a change of policy. In the former case the labor audit often brings automatic improvement. An investigator may go through a plant with the superintendent and ask such questions as "How often are the windows washed?" or "Who is responsible for plant housekeeping?" and return to the plant a few days later and find the windows washed and the shop carefully swept. On the other hand, when a change of policy is needed, something more than a bare statement of facts must be made.

Usually, an important result of a well-prepared audit is the awakening of the management to the need of a more progressive labor policy.

To make an adequate labor audit requires the following: First, a readiness on the part of the management and preferably of the workers also to put all relevant facts and records at the disposal of the investigator. Second, a properly qualified investigator, who may be a member of the plant's staff, such as the employment manager, or may be an outside consultant. Third, a method of conducting the audit and of reaching all sources of information. Fourth, a standard check-list, such as that given above. While it is possible to make a useful and fairly complete audit without interviewing any of the workers or even allowing them to know what is being done, the results are much better when the workers contribute and the best condition exists when the workers co-operate in the investigation.

A useful labor audit can be prepared without interviewing workers, but better results are possible when co-operation of the workers is obtained.

The principal sources of information for the investigator making the audit are interviews with executives, foremen, and workers, attendance at meetings, whether of executives or workers. and study of available records. It usually happens that a large part of the records that would be useful in making an audit are not available, simply because they have not been kept. The principal records of value are as follows:

(*a*) The number, causes, and cost of accidents.

(*b*) The amounts, causes, and cost of sickness.

(*c*) The amounts, causes, and cost of occupational disease.

(*d*) Figures showing the relation between wages and output; between hours and output; between labor turnover and output.

This correlation of data is highly significant. It may not always be possible to secure it; but there is unquestionably one of the most fertile fields for statistical refinement in this problem of correlating the figures on the production and the human side of the business.

(*e*) Length of employment of workers. It is important to know what percentage of workers have been at work for a given length of time.

(*f*) Wage groupings by (1) amounts in terms weekly and yearly incomes; (2) sex; (3) age; (4) length of service; (5) degree of skill.

This arrangement of wage statistics will almost invariably throw light upon the efficiency of the factory's payment methods and upon any serious discrepancies and shortcomings in the amount of pay. Admittedly factories do not compile their figures in this way, but if when the auditor commences his work he can call for a certain amount of clerical assistance in the factory, a great deal of these data can be collected during his visit—usually enough to make it possible for him to have a fact basis for his discussion.

(*g*) Records of labor turnover.

These records to be significant should be itemized in various ways, but especially by departments, sexes, length of service, amounts of pay, etc.

Most of the items on the check-list already given are self-explanatory. The job analysis is intended to give a statement of the character and elements of the work process, such as the kinds of jobs, the skill required at various jobs, the character of the product as affecting the work process, and the number of workers, also the time factors, including working hours, rest periods, the lunch interval, the amount and distribution of overtime, night work, Sunday work, and vacations, and the regularity of work throughout the year. The reason for classing inspection under training is that, when the work is returned to the worker and discussed with him from the standpoint of quality, inspection is definitely a part of training, and can contribute to improved quality.

The peculiar economic beliefs both of employer and workers may have an important effect on the labor situation of the factory, and they must be considered in making recommendations. In considering efficiency of the management, only those aspects of the case that affect labor relations should be considered, but it is easy to see how the efficiency of the production department affects the workers, particularly if they are on piece-work. The relation between the workers and the sales department is most evident for the seasonal trades, but any sales policy that causes large fluctuations in the number of workers employed has a bad effect on the worker.

The uses of the labor audit may be considered from four points of view: that of the management, of the employment manager, of the workers, and of the community.

The audit is obviously useful to the management as a method of standard record and careful analysis; but other uses at once suggest themselves.

The material incorporated into individual sections, together with the recommendations, can profitably be made the topic for discussion and for educational work in executives', foremen's, and workers' conferences. In a

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plant already well functionalized the different sections of the report would naturally be turned over for action to the executive charged with the responsibility for the function under consideration. But more than this is necessary. The audit has been made from the point of view of assessing the all-around human and social solvency of the organization or institution. And to the extent that this all-around point of view can be imparted to members of the executive staff by reading and discussing certain portions, if not all, of the audit, to that extent the broadest educational purpose will be served.

It will also be true, where a personnel department is in operation, that the audit can to a certain extent give the management a good estimate of its working efficiency. It can, in other words, be an audit of the personnel department. But it should be more than simply a statement. It should be definitely a working manual which, in the hands of all the personnel executives, can be used as suggestive of a point of view and of new methods.

Where new executives are being introduced, both into general executive work and into the personnel department, it is convenient to have in fairly compact compass a statement that makes clear how the company's labor policy is operating. If a labor audit is turned over to such new executives to read they can be more quickly instructed in the policy and methods under which the company operates. As a document for the instruction for new executives the audit can have peculiarly significant values.

Again, the conscientious and enlightened employer, who is appreciative of his social responsibility, should be able to find in the audit an estimate of the human solvency of his business. He should be able to get a clear picture of the problems that remain for the plant to solve, of the immediate steps that he should take toward their solution, and of the larger problems he should have in mind for solution over a period of years.

From the point of view of the employment manager, the labor audit has certain values which are to be obtained in no other way: (1) It enables him to know all the elements of his problem. This knowledge of the all-around aspects of the situation with which he is dealing is indispensable for the forming of a right and adequate policy. (2) It enables him to frame and suggest a policy calculated to meet his problem in a fundamental way. (3) It enables him to 'sell' his policy to the organization with the maximum effectiveness. (4) It enables him to carry on his own administrative work with greater success because of his greater knowledge. And (5) it enables him to improve his policy and practice because of the estimate of its effectiveness he has secured in the audit.

From the workers' point of view, one objection may arise to the labor audit. It may be said that the audit is simply a device to inquire into the workers' grievances before they have reached substantial proportions and to forestall, by preventive measures, any vigorous or direct action on the part of the employees. It may be objected, in other words, that the labor audit is simply being used to maintain the employer securely, and with a better conscience, in the control of a situation which may, from the broadest point of view, be precarious and unsound. From this point of view, the audit is salving the employer's conscience and equipping him with methods of administration that enabled him to maintain himself more securely in a basically autocratic position.

The answer to this objection is clear. The labor audit is primarily an instrument of inquiry. It is an instrument used to the end of discovering unscientific, inhuman, and socially inexpedient policies and methods in the labor relations of an organization. In so far as it is simply an instrument of precise analysis it stands on its own feet and is of use to anyone who is in search of a method of exhaustive study. The fact that an instrument of any sort is capable of dangerous misuse has never been an argument against the use of the instrument. It has simply been an argument for its use in the right hands and with the right purposes.

The labor audit is primarily an instrument of inquiry. The fact that an instrument of any sort is capable of dangerous misuse has never been an argument against the use of the instrument.

As a matter of fact much can be derived by organized workers and by the community from the use of labor audits for other than managerial purposes. The time will come when the organized workers will on their own behalf (or jointly with the employers) undertake just such systematic analyses of the conditions and terms under which their members work. Increasingly as the unions see themselves in need of accurate facts, both for the protection of the health of their members, for their instruction, and for the information of the public, they will see the need of a method of inquiry which will at least approximate that of the labor audit.

Considering the second aspect of this objection—that the recommendations of the audit indicate methods that will perhaps make the workers content with a relationship which is fundamentally inequitable—the answer is that in the use or abuse of this method much depends upon the view of the auditor. His recommendations may be farsighted, or they may be of only temporary alleviative value. But whoever owns the shop and whoever controls the shop, the problem of maintaining a cordial relationship between manager and managed persists. In the administration of that relationship, as well as in the administration of the correlation of the different departments of the factory, there is under any ownership the necessity for as scientific and precise a method of organization and practice as can be devised.

Whoever owns the shop or whoever controls the shop, the problem of maintaining a cordial relationship between manager and managed persists.

As public responsibility for the proper conduct of public utilities is more and more stressed, and to the extent that it is insisted that the interest of the public is paramount, it will be a public obligation to have the facts about the operation of the labor policy of public

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utilities constantly at the disposal of the public. Most of the material that a labor audit contains should not simply be a matter of public record where public service corporations are involved. It should be a matter for deliberate publicity in published reports and newspaper articles.

In some of the most critical of the recent strikes in street-railway transportation, for example, if the public had known accurately what the facts were in advance of the interruption of work, it would have brought pressure to bear on both sides in advance to effect a modification of policy and practice which would have made the strike unnecessary.

But there is a still wider field for the audit's usefulness. It is increasingly recognized that State industrial commissions have not simply a regulative but a preventive and constructive function. In order successfully to perform that function for all of industry, there is needed more information about every factory, a more penetrating and inclusive view of each factory's problem. The time may not be far off when State labor commissions will institute what will in effect be bureaus of labor audit and research.

The results of the labor audit hinge largely on two factors—on the character, capacity, and conviction that the auditor himself carries; and on the inclination of the interested parties to act upon the recommendations that are made. Assuming that these two conditions have been successfully met, it is possible to indicate several tangible and beneficial results.

In the first place, the audit should increase the ability of those who determine personnel policy to see that policy as a rounded whole, to see that there are no panaceas in this field, and to see that a great variety of problems must be attacked, if conditions are to be bettered and more just relationships established. This is an incalculably desirable result since, as has been said, the tendency of executives is to pursue hobbies and panaceas as solutions. The audit should also bring immediate correction and improvement in execution of numberless details of policies that have already been determined, but which have slipped into disuse. But a more positive function should be served by laying out a long-time program and plan of action of personnel relations on which a company can work for years to come.

The labor audit should be the means of laying out a long-time program and plan of action of personnel relations, on which a company can work soundly for years to come.

From the point of view of labor organizations, the results of the labor audit look in the direction of getting both the conditions and the government of industry upon a fairer and more equitable basis. The immediate result will be to inform the workers in a concrete way as to the practical success, from their point of view, of the structure of government which exists in a given locality or plant.

It can finally be said that as soon as the labor audit is used as an instrument of public investigation and oversight in industry, it will bring to light a vast number of discrepancies and inadequacies in the administration of industrial personnel work which will be almost automatically corrected once the light of day is let in upon them.

Robert F. Hoxie has characterized the existing condition that the labor audit is calculated to correct when he says that "in labor contests no foreknowledge exists; there is no machinery for getting it, no enlightened public opinion; there is arbitrary disregard of public rights, false claims, and a helpless public".

"We must," he continues, "have means for developing a body of exact and truthful information; developing common standards of right and justice (maxima and minima or rules of the game); developing a real public opinion back of them, developing a constructive social program; getting centralized, strong, able, elastic administration and enforcement of laws, with a view to the whole situation; getting and applying knowledge and standards to control, and in the settlement of contests, creating to this end social interactions. This understanding and knowledge can be secured only by the closest first-hand study in the field. It is all a matter of doing the work in a calm, orderly, large-minded and farsighted, constructive, and scientific manner."

THE following are the rules of the road that govern motor drivers in Japan:

"At the rise of the hand of policeman, stop rapidly. Do not pass him by or otherwise disrespect him.

"When a passenger of the foot hove in sight, tootle the horn trumpet to him melodiously at first. If he still obstacles your passage, tootle him with vigor and express by word of the mouth the warning, 'Hi! Hi'.

"Beware of the wandering horse that he shall not take fright as you pass him. Do not explode the exhaust box at him. Go soothingly by.

"Give big space to the festive dog that make sport in the roadway. Avoid entanglement of dog with your wheel spokes.

"Go soothingly on the grease mud, as there lurk the skid demon. Press the break of the foot as you roll round the corners and save the collapse and tie up."

HE WAS a self-made movie director and he had his own ideas about things. The company was going in for religious films, and the director struggled with an unfamiliar Bible in an effort to get the production 'over big'. In the middle of the work his camera-man drew his attention to an oversight.

"Hey, Bill," he said. "You forgot them twelve apostles. We got to use 'em in the second cut-back."

"Twelve?" snorted the director, contemptuously. "Where do you get that? Make it forty. Tell 'em to wave their swords and yell so we can work up some mob stuff. Whatinell kind of a close-up would twelve apostles make?"—Los Angeles Times.

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Permanent Molds and Centrifugal Castings*

By J. E. HURST

The use of permanent molds for the production of castings in both ferrous and non-ferrous metals has made rapid strides. In the non-ferrous metals, particularly the light aluminum alloys, the production of castings in permanent molds, or dies as they are frequently termed, is now common, and the higher melting-point yellow metals such as aluminum-bronze, are now also cast in dies. For ferrous castings the production of castings in metal permanent molds has developed considerably, but not to the same extent as for non-ferrous metals.

The system of pressure-dies as applied to ferrous casting, as far as my knowledge goes, is not being applied commercially, and I do not know of any extensive experiments in this connection. The reason for the lack of any development in the application of the ordinary system of pressure die-casting to ferrous metals is the difficulty of constructing pressure die-casting machine-parts capable of withstanding the considerably higher temperatures. Die-casting in cast-iron is for the most part done with stationary metal molds or dies. The dies or molds used for this purpose can be divided into two main classes: (1) dies that are made throughout of metal; (2) dies in which the external form only is obtained by the use of a metal mold, the internal form being obtained by using sand cores as for ordinary castings.

In castings having a plain cylindrical interior form it is practically always possible to construct the dies of metal throughout. With castings of more intricate internal form, sand cores are frequently used, the external form being obtained by the use of a metal die as before. The designing of metal cores of intricate shape calls for much skill and ingenuity. Intricate molds, and particularly intricate metal cores, are expensive to make, and entail costly experimental work before satisfactory results are obtained. The manufacturer frequently hesitates at the heavy initial expenditure, and sand cores present a cheaper and ready means of reducing the initial costs. Further, for the majority of castings the use of a sand core, together with a metal die, does not appreciably reduce the metallurgical advantages of die-casting.

The material used for the construction of metal dies is almost always cast-iron. Gun-metal and steel are used mainly for non-ferrous castings. One authority considers that the use of cast-iron for dies is a possible source of pinholes and blow-holes, and recommends the protection of the die by a facing material such as plumbago, shellac, or lacquer, or by a coating of lime. He further suggests the use of some wrought material such as nickel as a material for die construction as being the ideal means of avoiding the above trouble. In my experience the occurrence of pinholes in cast-iron die-castings made in stationary dies is entirely a question of the temperature of both the metal and the die, and is not influenced by the cast-iron die unless, of course, this is in a badly disintegrated state.

The iron blocks from which the dies are made are usually cast in a heavily chilled mold. This procedure is to be recommended for the production of dies in ordinary commercial cast-iron.

The chief trouble experienced in the use of cast-iron dies are cracking and distortion. In certain circumstances such dies have been known to crack after being in use for a short time. In these cases the cracking can for the most part be traced to defective designs of the dies, and to internal defects such as blow-holes and porosities in the die material. Failure of dies may also come from a peculiar form of surface cracking and disintegration, which ultimately causes the complete fracture of the die. The surface-cracks in one typical example extended to depths into the metal varying from $\frac{1}{8}$ to $\frac{1}{2}$ in. This cracking is accompanied by a sort of swelling of the surface, which becomes porous and spongy. With dies in this condition, trouble is experienced from difficulty of extraction of the castings from the mold, defective surface-appearance, and pinholes. This surface swelling and cracking is the result of internal oxidation arising from the repeated heating of the die. Continued use of dies in this condition causes extension of the surface-growth into the interior of the dies, and finally the complete fracture of the die.

The rapidity of the internal formation of surface cracking in dies to any serious extent depends entirely on the maximum temperature attained by the die in use. Growth commences at temperatures from 650 to 700°C. It is necessary, therefore, to have the dies thick enough to prevent this temperature being regularly obtained. I remember a large die that produced 2500 castings before this surface defect became sufficiently serious to warrant the rejection of the die. Much longer life even than this can be obtained, and I have been told that a particular die, producing castings of an average thickness of $\frac{1}{2}$ in., the average thickness of the die being 2 in., lasted some 3000 to 5000 castings.

Like cracking, the distortion trouble experienced in dies can be frequently attributed to defective design of the die, permitting the heat to produce internal stresses that ultimately cause permanent distortion and frequently cracking of the die.

Apart from the effect of bad design, permanent distortion in the mold appears to be caused by the gradual decomposition of the combined carbon. The best method of reducing these troubles to a minimum is the use of an iron with low combined carbon. The temperature to

*From paper presented before British Foundrymen's Association.

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which the die is subjected appears to have little ultimate influence on the distortion, as whatever the temperature, the combined carbon content is ultimately decomposed, particularly if the silicon is in excess of 1.5%.

In the production of die-blocks of cast-iron, closeness of grain is an essential feature, as this tends to minimize the rapidity of surface growth. The production of low combined carbon material, at the same time having a close grain, is frequently a difficult matter, particularly in thick dies cast in sand. The use of chilled molds is therefore advisable.

In the centrifugal process castings are produced by introducing the molten metal into a metal die, or permanent mold that is rotated at high speed. The molten metal takes the required form of the mold as a result of the centrifugal action.

Most castings having a cylindrical internal form can be produced by this process. The external form need not necessarily be strictly cylindrical, and castings having considerable variation in the shape of lugs, projections, and fins on the external face can be produced by this process. The following list of castings gives some typical examples of the application of this process. Air-cooled motorcycle and automobile engine cylinders, having detachable heads; sleeves for sleeve-valve engines; close-grained cast-iron tubes for valve-seatings; hydraulic cylinder and pump barrels; large size cast-iron gear-blanks. A wide range of plain cylindrical articles can be produced by this process. Some of the advantages of the centrifugal process over ordinary die and sand castings are: absence of gates, runners, risers, and feeder-heads; absence of cores; ease and rapidity of production; absence of fettling.

An interesting phenomenon, which might possibly be claimed as an advantage peculiar to the centrifugal process, is the segregation of all the lighter insoluble constituents to the inner surface. As a result of the centrifugal action, slag and dirt on the surface of the metal collects on the inner surface of the casting, from which it can easily be removed by a flushing process. Similarly, the sulphur existing in the iron as the insoluble (at the temperature of cupola-cast metal) manganese sulphide tends to be segregated to the inner surface of the casting. On thinner castings this is not so marked, because of the comparatively rapid solidification of the metal, but on a thick casting such as a turbine-gland a noticeable segregation can be obtained. The analyses given below illustrate the extent of this segregation:

Inner surface	%	Outer surface	%
Manganese	0.60	Manganese	0.33
Sulphur	0.23	Sulphur	0.06

A final advantage of the centrifugal process is the soundness of the castings produced. The mold is filled by consecutive layers of molten metal, that are evenly applied parallel to the axis of the casting. Under these conditions, and with cores eliminated, there is no danger of the formation of blow-holes or contracting cavities, and the castings are sound.

Die-cast iron castings possess distinct advantages over ordinary sand castings, the foremost of which is the fine grain-size. The grain-size of any fine-composition cast-iron is, generally speaking, dependent on the rate of cooling. The more rapid the rate of cooling the smaller the grain size. By the use of metal dies the rate of cooling of the cast-iron is considerably increased, with a resulting increase in the fineness of the grain. The obvious danger is the possibility of the rate of cooling being sufficiently fast for chilling to take place, giving the casting a hard unmachinable white-iron skin. This, however, can be avoided by a suitable adjustment of the composition of the iron, the thickness of the mold, and the temperature of the metal and mold before pouring.

Intimately connected with the grain-size is the possibility of the production of low combined-carbon cast-iron and at the same time showing fine grain-size. This is difficult to do in sand castings, for the silicon content, as a general rule, must be so high as to produce an open-grained cast-iron, particularly in castings of large cross-sectional dimensions.

'Fish-Scaling' in Enamels for Sheet Steel

Among the investigations being conducted by the U. S. Bureau of Standards is one with a view to the elimination of 'fish-scaling' in enamels for sheet-steel. A recent report says:

The jumping off of small particles of enamel, which results in the defect known in shop practice as 'fish-scaling', is probably the most serious defect to which enamels for sheet-steel are subjected. It occurs intermittently in practically all the plants manufacturing this class of material in this country and entails losses running into millions of dollars to the manufacturers. At the request of the Metalware Manufacturers' Association of America, the Enameled Metal Division of the American Ceramic Society, and of a large number of individual manufacturers, the bureau is carrying on a comprehensive research to discover the cause or causes of this defect and the methods of controlling and eliminating it.

Up to the present time the bureau has made 90 melts of enamel comprised of 21 different compositions. These have been subjected to various treatments in firing and melting and have been applied in various ways to several kinds of steel. In all, over 4000 sample enameled plates have been made up to date. This work has demonstrated that one of the most important factors in the production of fish-scaling is too severe heat treatment in the firing of the enamel. Excess heat treatment may consist of firing the enamel at too high a temperature or of holding the enamel in the furnace for too long a time at a given temperature. Other important factors are the composition of the enamel, the physical and chemical characteristics of the underlying metal, the method of melting the chemical mixtures used in making the enamels, and the shape and weight of the metal pieces that are enameled.

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INDUSTRIAL EQUIPMENT

MACHINING LARGE CRANK-SHAFTS

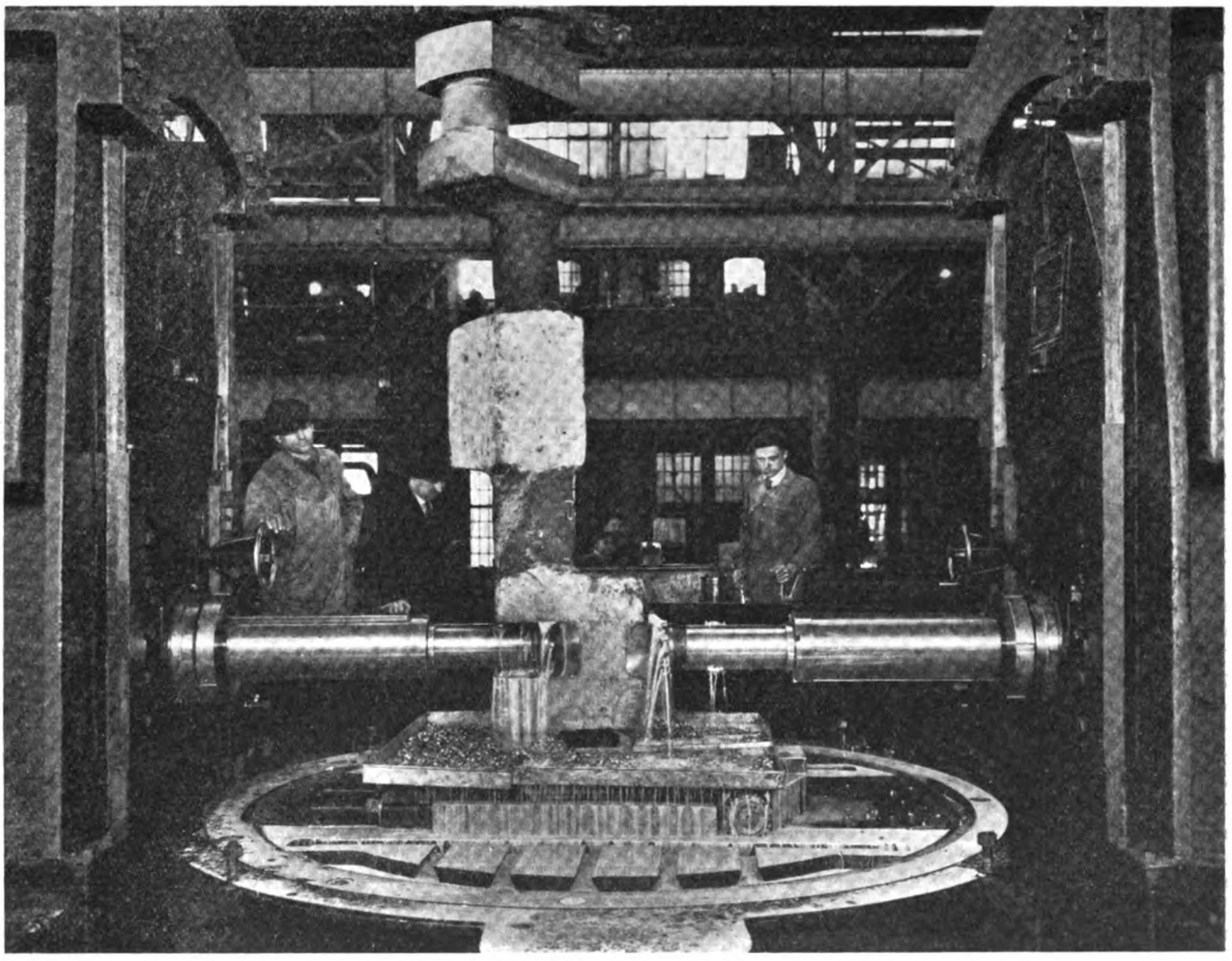
The ordinary method of machining large crank-shafts leaves much to be desired as regards accuracy, principally because of the necessity of hanging the shaft eccentrically for a large part of the work. To obviate this difficulty, Burmeister & Wain, of Copenhagen, Denmark, developed the equipment described below, the rights to which have been acquired by the Midvale Steel & Ordnance Co., of Philadelphia.

The new method is mainly applicable to crank-shafts made in one piece, although it is also used to great advantage on crank-shafts where the pins and webs are integral and shrunk on the journals. In the old method of built-up shafts it was necessary to make the throws long enough to have sufficient metal between the web-holes for pins and journals in order to get strength. With a solid shaft it is possible to have the pins and shaft contours tangent to each other or even overlapping, and thereby reduce the weight of shaft, if so desired.

As the tendency with designers of large gas-engines has been to use shorter strokes than with steam-engines, the facility with which short-stroke crank-shafts with webs and pins integral can now be manufactured, should commend the new method to gas-engine designers.

In order to understand better the importance of these machines and the improvement they mean in the manufacture of crank-shafts, it will be necessary to give a short resumé of the old method usd in machining such shafts. The crank-shaft forging as it came from the forge department was drilled and slotted to remove the excess metal between the throws. The section of shaft would in this way be left square with ragged edges, and was rounded roughly in a lathe, after which the shaft was again taken to the forge department and heated locally and twisted so as to bring the various throws into their correct relative position. Then the shaft was again taken to the machine shop and the previous drilling and slotting operations repeated to remove the excess metal in the throws themselves. The journals and ends of webs were then roughed in a lathe. Next the pins were rough-turned in a lathe of very large swing, so that the shaft could be hung eccentrically with large counterweights to balance the load. The webs were then planed. After having roughed the shaft all over in this way, the pins were finish machined in a similar manner to that described above for the roughing. In order to centre these pins properly it was necessary to use spiders fastened on the shaft. As the shaft was hung eccentrically, it caused irregular loads on the lathes, even if counterbalanced. The spring of the shaft also caused trouble, and all these considerations necessitated slow running. Even then, in spite of the greatest care in machining, the pins would be considerably out of true, requiring much hand-filing afterward. The next operation would be the finish-turning of the journals, and finish-planing, after which the shaft would be complete except for the rounding and lapping of the pins. Most of these operations wasted much time and required considerable skill in getting approximately accurate results.

The new method makes all drilling, slotting, and planing



Milling Crank-Shaft

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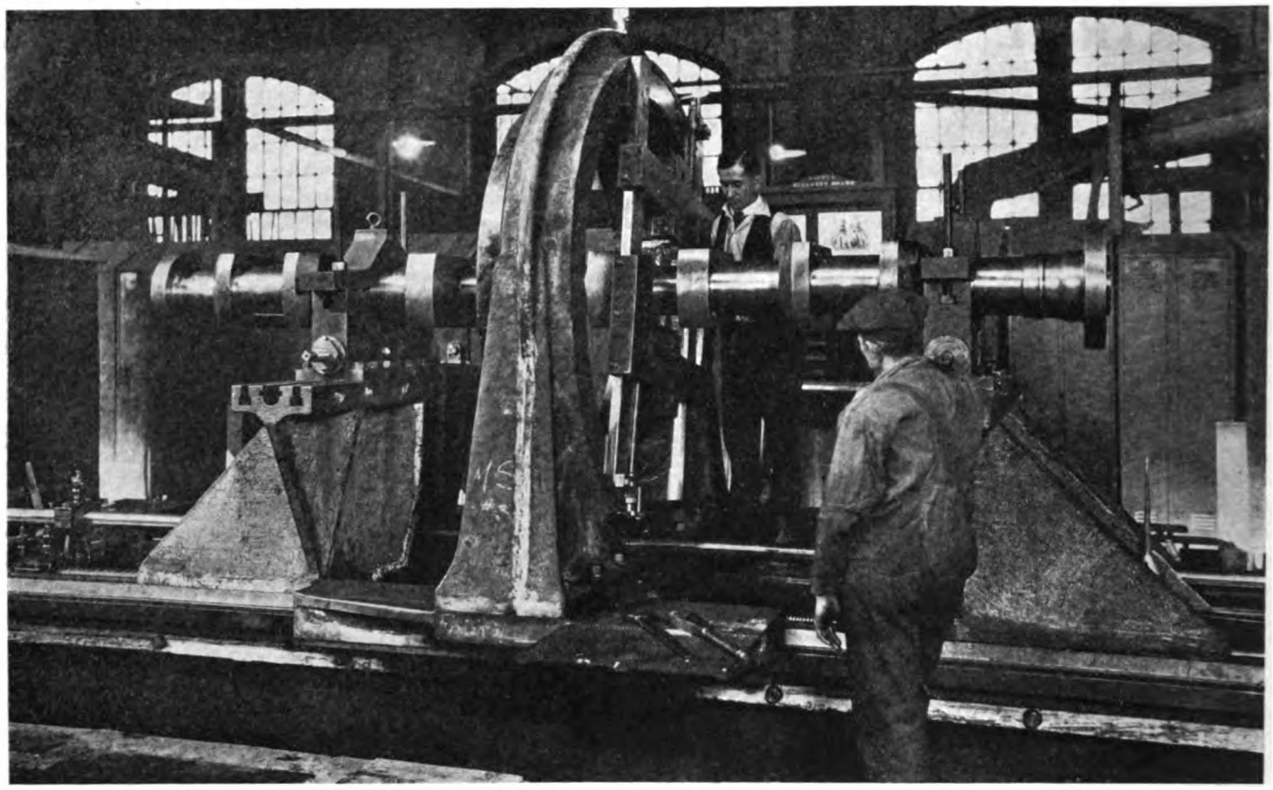

Shaft set up for Machining

unnecessary. The shaft is supported vertically in a double-ended horizontal milling-machine with a centrally-rotated table, in which there is a large opening, permitting the shaft to be shifted with its chuck eccentrically with the centre of the machine. The first operation is placing the shaft concentric with the machine, so that the excess metal between the throws can be removed prior to twisting. The next operation is the twisting as formerly done, after which the shaft is taken to a lathe and all the journals roughed. Then the shaft is again taken to the milling-machine and all the throws milled. This time, however, the shaft is set eccentrically so that the centre line of the pin on which the work is being done is central with the machine. In the same setting the sides of the webs are milled parallel to blue-print size, and the ends rounded as required. The next operation is again on a lathe for truing journals in order to remove inaccuracies caused by the springing of the shaft in removing the metal in the throws. The pins are then finished in a pin-machine in which the crank-shaft is stationary and the tools revolve around the pins. The final operation is again in a lathe requiring the finish turning of the journals and collars, after which the shaft is completed, no hand-work at all being required to make pins true with the journals and round. The number of operations is greatly reduced and simplified and the setting of the job is much easier. Especially are all the eccentric lathe-settings omitted, so that lathes of smaller swings can be used. All the work is done on one set of centres in the ends of the shaft, which method helps to produce shafts of much greater accuracy than could formerly be obtained.

While this method is new in the United States, it has been in use in various parts of Europe for some years past, and has been tried out thoroughly. The result of these years of experience has been embodied in the present machines and methods. The Midvale Steel & Ordnance Co. sent engineers to Europe so that they might become familiar with the operation and capacity of the machines, and obtained all the latest data before the patents covering both the method and machines were purchased.

The illustrations accompanying this article are self-explanatory, but a brief description of the machine will help in making the photographs easier to understand. The device is in principle a double-ended machine with two distinct and separate units on either end; each unit being complete with a driving motor, horizontal milling-bar, with horizontal, vertical, and radial feeds, all being driven from a 50-hp. motor on each unit. The crank-shaft is supported in 'V' chucks, movable in proper guides on the central table, so that the shaft can be set either centrally or eccentrically. The table can be rotated at various speeds, or can be locked in any position desired. This table is driven by a separate motor.

A milling-head is used on each spindle, the head having a diameter corresponding to the desired gap between the webs. For roughing the metal between the throws, the shaft is set centrally. To remove the metal in the throws themselves, the pin is set centrally with the shaft eccentric to the amount of the throw. In both cases the milling operation is the same; the table is rotated, and both spindles rotate with their heads, causing the metal to be removed, and gradually rounding the pin. When the desired diameter has been obtained, the table is set with the cheeks of the web parallel to the side-shears of the machine and locked in this position. The housings with their spindles are then removed transversely parallel to the centre line of the machine, and in this way the cheeks are machined parallel and to the proper width. If the drawings call for the ends of the web to be rounded, the shaft in its 'V' chuck is moved to a position coincident with the centre of rotation required, and the ends are milled to the proper radius, of course with the table rotating. The webs being finish machined on the edges and ends, require, besides the usual roughing-head, also a special finishing-head which leaves the faces with smooth surfaces. In machining the first crank the shaft is generally hung in the pit with only the first throw above the table, the shaft being gripped below the throw. When this throw is finished the shaft is lifted by a crane to machine the next throw. After this second throw is machined the shaft is

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taken out and reversed, so that for a four-throw shaft, there will never be more than two throws above the surface of the table. This is done in order to reduce vibrations, although the machine in actual tests has had the whole shaft above the table. While it is the usual practice to machine only the throw immediately above the clamp, the oufit has at times machined even the second throw above the chuck without any undue vibration, but this is not a desirable procedure. If for any reason the vibrations synchronize with the vibrations of the machine, this can be stopped immediately by simply changing the speed of one of the spindles, so that the vibrations are always under control. The machine is of sturdy construction, weighing about 250,000 lb. The housings are double, having four guides on the cross-head and a guide for the rear-end of the spindle. This tends to great rigidity, and the entire cross-head is counterbalanced. The housings themselves have long and wide bearings on the horizontal shears. The main gears throughout the machine are either steel or bronze, with a few unimportant cast-iron gears. Most of the gears are helical gears, which also tends to smoothness of running. A number of clutches are provided for actuating vertical, horizontal, rotative, and in-and-out feeds. Besides this the spindles can also be fed by hand. The driving motor for the table is 37½ hp. Lubrication throughout is by gravity sight-feed except for the large gearings where additional grease or oil-cups are provided. A three-cylinder pump lifts the cutting-compound from the pit to the cutters; this pump being driven by an independent 5-hp. motor, proper precautions being taken in the pits to prevent stray chips from getting into the suction and stopping the flow of the lubricant.

A PERMANENT MACHINERY EXPOSITION AND SALES-CENTRE

By Howard R. Ward

The number of machinery manufacturers in the United States has increased largely in the last few years. Plants are now found in almost all sections of the country. Machinery has not only greatly increased in diversity, but a similar expansion has also taken place in the manufacture of appliances and supplies. The products of these manufacturers are sold not only in America but in most parts of the world.

Many channels are used to bring these products to the notice of prospective consumers: advertising in the trade journals which have become effective channels of information in their various fields; extensive use of technical salesmen; advertising in the popular journals; circularization; personal correspondence. The methods have in fact become so numerous and the market so wide that the manufacturer cannot take advantage of them all and finds it necessary to choose only certain fields and to limit his methods of reaching those fields.

The consumer is in much the same position. Formerly he was in close touch with the one or two concerns which were the only ones who could supply him with the machinery and supplies that he used in his business. Today in attempting to secure what is best suited to his needs, he must study all appropriate advertising mediums, he frequently travels extensively to visit manufacturing plants, and he must keep the data he collects in available shape, and up to date.

One possible solution of the increasingly difficult problem is to establish a permanent exposition and sales centre at a point as mutually convenient as possible for the manufacturer and for the domestic and foreign consumer. A sales-centre for machinery and kindred appliances and products, once permanently established in a proper location, would unquestionably be of value to both the manufacturer and the consumers. Though some attempts have been made that have resulted in failure, the reason has always been evident; either the scope was too limited or the location was not central or convenient. Some attempts have succeeded in foreign cities and also in this country, but in all cases their success or lack of success has been governed by their location and scope.

New York city has become more and more the logical place for a permanent sales-centre. It is visited regularly by manufacturers, operators, buyers, and engineers from all parts of the world. The Grand Central Palace, a twelve-story reinforced-concrete building, occupying an entire block, is to become just such a sales-centre. Eight floors, each containing approximately 50,000 sq. ft. of floor space, are to be devoted to the permanent display of machinery, mechanical appliances, and all allied products. The lower floors will continue to be used as heretofore for short-term expositions such as the Chemical Exposition, Automobile Show, and the like. The location of this building, in the Grand Central zone, is ideal. It is within close reach of the railway terminals, the hotel district, and technical libraries.

This permanent exhibit will be known as the 'International Exposition of Industries', and its scope on mechanical lines will be extremely broad and comprehensive. Exhibits will include farm tractors and mining equipment, construction machinery, and other commodities. It will cover the widest possible range of mechanical devices. The mining section will include machinery and appliances for the production of coal, metals, minerals, and petroleum. In other sections will be found machinery and devices used in the various mining industries but not manufactured primarily for these fields.

In working out the details of the project the organizers have kept in mind certain important factors. It was realized that the cost of exhibiting should be kept as low as possible and that the service given the exhibitors should be worth more than the cost of exhibiting. The services usually found in all up-to-date office buildings will be available, and will include elevator service, janitor service, light, heat, and power. In addititon to these services, attendants will be stationed on each floor. These attendants will be technical, practical, experienced men, able to explain to visitors the purpose and method of operation of the appliances exhibited. As a result of this service it will not be necessary for manufacturers to keep their own technical salesmen in attendance. When visitors are found to be in the market for immediate purchases they will be placed in touch with the manufacturers' salesman. The institution of this permanent exhibit and sales-centre in the Grand Central Palace will offer many advantages to exhibitors besides the benefit of a central point for exhibition, demonstration, and sale of their products. The great value of interchange of thought in industrial efforts is now well recognized and the 'International Exposition of Industries' will give this stimulus to manufacturers, engineers, operators, and consumers. It will not only bring direct benefits to producers and consumers, but will result in broadening and stimulating the fields and efforts of each industry.

GASOLINE-ENGINE DRIVEN GENERATOR SETS

The requirements of the Army during the War brought particular emphasis to the fact that for certain work and conditions an independent portable source of power and light is desirable. Gasoline-engine driven generators of various sizes were employed extensively to great advantage.

The Allis-Chalmers Manufacturing Co. furnished a large number of these sets to the Government and their success in operation under the exacting conditions has thoroughly demonstrated their reliability as apparatus for general use.

Two sizes have recently been placed on the market: 5-kw., 110 or 220 volts, and 15-kw., 110 or 220 volts.

These sets employ four-cylinder, four-cycle gasoline engines of the automobile type, which are of ample size and

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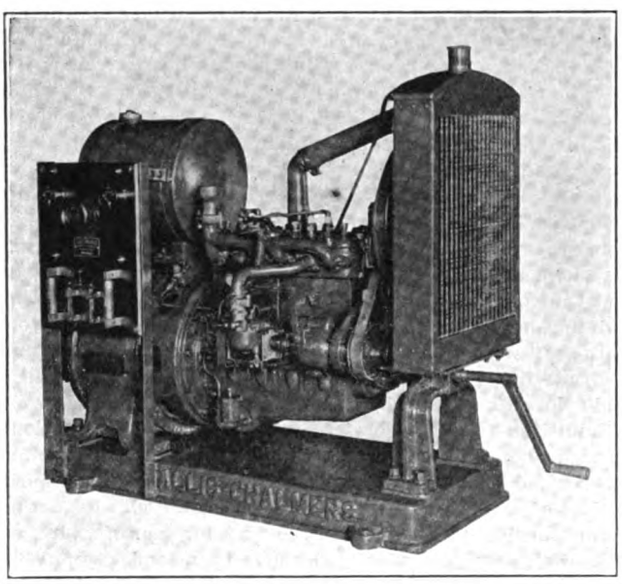
rating to withstand continuous full-load service without being over-taxed. The engines will carry momentary overloads up to the ultimate capacity of generators without bringing undue mechanical strain on any of the working parts. They are equipped with standard magnetos, carburetors, water-circulating pumps, tubular-type radiators, and fans. Governors are provided which positively regulate the speed to within 4% of the set speed of the engine from no load to full load. The generators are provided with compound windings proportioned so that the voltage variations do not exceed 2% from the set voltage from no load to full load.

The 5-kw. set shown in the photograph has three main bearings; one being the standard ring-oiled generator bearing, the other two being in the frame of the engine. The generator is held in accurate alignment by a rigid barrel housing which is machined to fit shoulders on the motor and generator frames. A coupling on the generator shaft fits into a recess in the flywheel and is bolted rigidly to it. The flywheel and coupling are enclosed in the barrel housing.



5-kw., 110-volt Generator Driven by Gasoline Engine

This construction gives a very compact arrangement and one in which the bearing alignment does not depend upon the rigidity of the base casting and foundation. In this set the gasoline-tank is mounted above the generators with gravity feed to the carburetor. The switchboard is mounted on angle irons attached to the base casting.

The 15-kw. set is in some respects different in construction from the 5-kw. set. The generator is provided with front and rear bearing-housings and is coupled to the engine by means of a flexible coupling. The gasoline-tank is rectangular in form and is mounted in the base under the engine. The gasoline is raised to the carburetor by means of a vacuum system similar to that widely used in automobile construction. In this set the switchboard is separately mounted and may be placed in any convenient position.

These sets make available a source of power and light which is flexible in application and comparatively cheap. Even in localities where electricity is available it will be found cheaper and more expedient in many cases to have an independent portable source of power and light. Central stations usually exact a charge for installing a meter and wiring and a minimum rate for electricity.

Concrete-mixers, hoists, centrifugal pumps, reciprocating pumps, air-compressors, and many other types of machinery can be economically and efficiently operated by electricity.

Without an independent portable source of electric power, the use of the most efficient electrically operated tools and equipment is impractical because of the uncertainty of being able to get electricity at all, because the voltage or frequency may be different in different places, and because of the delay and expense in getting meters and wiring from supply circuits installed.

FLEXIBLE SHAFTING

The Stow Manufacturing Co. of Binghamton, New York, builder of portable tools, is distributing a valuable booklet entitled 'Flexible Shaft'. A dozen special uses of flexible shafting are discussed and some general information regarding its manufacture and utility is given. The following is quoted from Bulletin No. 104:

"Flexible shafting consists essentially of an inner core constructed of built-up wire coils and a protecting casting with bearings and suitable fittings for the transmission of power from some source such as an electric motor, countershaft, or engine to the tool. The core in the shaft is brazed or soldered into end fittings, assembled in a reinforced leather or metal casing which supports the bearings, and is held in the case in such a way that when the shaft is bent no strain will come longitudinally on the core. This is very important, since the cores are not designed to resist end pull. The design of flexible shafts usually includes a sliding connection of some kind to take care of this feature.

"Flexible shafting does not compare with the solid shafting in the matter of strength, since this must be sacrificed to obtain flexibility. The bearings must be constructed to withstand harder usage than those for solid shafts, due to the vibration which follows from the design and which cannot be eliminated. However, in spite of these disadvantages the flexible shaft finds many applications where the solid shaft could not be used. The standard shaft is designed to run clockwise and will transmit only two-thirds of its normal power when operated in the reverse direction. Shafts may be obtained, however, for left-hand operation. Keep flexible shafts and tools well oiled. The flexible shaft is a bearing for its entire length and should be treated accordingly. To oil, use unsalted tallow, lard oil, or animal oil. Never use mineral oil, especially when leather or fabric cover is used, as such oil has a tendency to rot it. When oiling, disassemble shaft, remove the core, and immerse in the lubricant, taking care not to subject the core to rough handling while out of its bearings. Examine the shaft thoroughly each day. Axoid sharp bends and support it as much as possible. If the shaft begins to buckle it is overloaded, and the only remedy is to relieve it at once."

SLIDE-RULE FOR COMPUTING WEIGHTS

The average man believes that only those who have obtained two or three college degrees in mathematics is competent to use a slide-rule, and consequently he neglects to make use of one in his daily work, although there are a number of rules that can be used to advantage by anyone with a knowledge of ordinary arithmetic. This is particularly true of the weight slide-rule developed by Theodore Haase, of 252 Fremont street, San Francisco.

This weight slide-rule was designed to meet the requirements of blacksmiths, estimators, foundrymen, patternmakers, stock-keepers, and auditors, in fact everyone whose daily duties involve the figuring of weights. With its aid considerable time and energy can be saved.

Attention is called to some features of this rule that simplify its operation as compared with ordinary slide-rules, particularly in computing weights, namely: Common fractions are graduated where needed instead of decimals. Length can be read in either feet or inches, while thickness and widths are given in inches. The double slide permits

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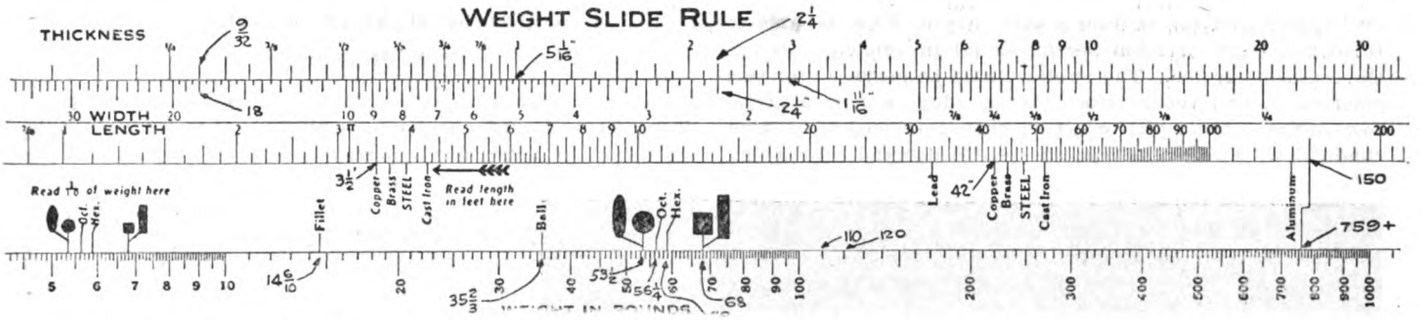


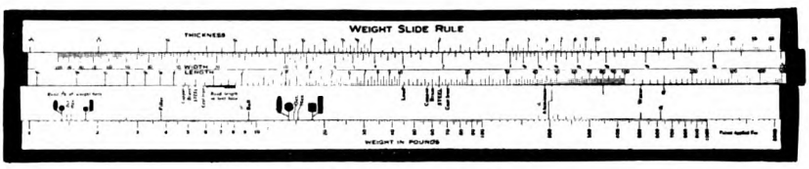
THIS CUT SHOWS A PORTION OF RULE SET TO FIND:

Weight of Copper 5 1/16″ x 1″ x 42″ long = 68 pounds
" " " 2 1/4″ dia. x 42″ " = 53 1/2 "
" " " 2 1/4″ hex. x 42″ " = 59 "
" " " 2 1/4″ fillet x 42″ " = 14 6/10 "
" " " 9/32 x 18″ x 42″ " = 68 "

$5\ 1/16 \times 150 = 759 +$
$(2\ 1/4)^2 \times 150 = 759 +$
$5\ 1/16 \div 9/32 = 18$

$(2\ 1/4)^2 = 5\ 1/16$
$3 \times 1\ 11/16 \times 150 = 759 +$
$18 \times 9/32 \times 150 = 759 +$

$\sqrt{5\ 1/16} = 2\ 1/4$
$9/32 \times 18 = 5\ 1/16$
$3 \times 1\ 11/16 = 5\ 1/16$



The Haase Weight Slide-Rule

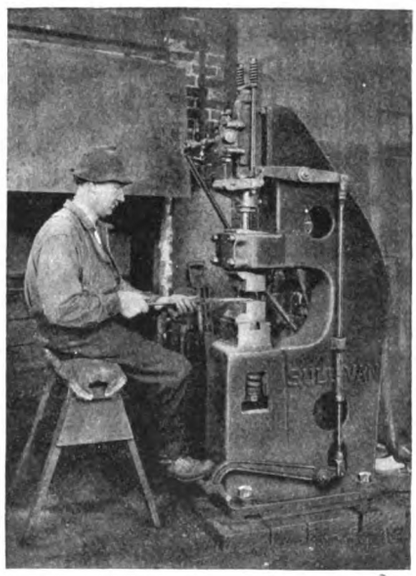
two operations in one. Answers read direct, no pointing off decimal places being necessary.

A book of instructions is furnished with each rule, examples being given showing exactly how to obtain weights. Miscellaneous calculations are also given, such as circumference of circles, area of circles, gallons in tanks, etc., also a table showing how to obtain the weight of an irregular object by dividing it into regular sections and computing each section separately.

THE SULLIVAN UTILITY FORGE-HAMMER

For general light forge work on round or square stock not more than 2 in. diam., the Sullivan Machinery Co. has developed the hammer shown in the occompanying illustration. It is designed for either steam or compressed air at 80 to 100 lb. Using air at 90 lb. the consumption is 93 cu. ft. per minute. Using steam, 8 boiler-horsepower is required. The net weight of the machine is 1675 pounds.

The hammer consists of a rigid cast-iron frame, which supports the anvil or base-block; the guide for the upper or striking-die; and a vertical engine or hammer, similar to that used on Sullivan drill-sharpeners. Compressed air or steam is admitted to the hammer cylinder through a pipe connected with the air-receiver or boiler, and live air or steam is kept in the lower end of the cylinder at all times by means of a pin or spiral spring acting against the lower end of the valve. When the foot-lever is depressed, the pin falls, the valve starts, and the hammer begins to strike. The piston-rod of the hammer is tapered at its lower end to receive the guide-block, to which is keyed the upper of the two swaging-dies. The guides are substantial in their dimensions and material, and are carefully machined to provide for accurate alignment of the dies and guide-blocks. The engine or hammer consists essentially of a modified Sullivan rock-drill with differential valve-motion. This ensures economy (no power is used except when the foot-lever is depressed), long life, and sustained efficiency. When running at full speed, the hammer strikes 600 blows per minute. By regulating the pressure on the foot-lever, the operator can vary the length and strength of the blows from a light tap on short stroke up to the full power of the machine. The travel of the foot-lever is long in proportion to



Hammer Forging a Chisel

the length of valve-travel, which renders operation easy for the smith, and gives him absolute control.

THE PROBLEMS OF THE RAILROAD COMPANIES

Seth Mann, traffic manager of the San Francisco Chamber of Commerce, appeals to shippers to be patient with the railroad companies until they have had time to readjust their organization after more than two years of Government control. He says that the first year after the return of the railroads to private control will be one filled with difficulties and obstacles to be met by the private carriers. It may be fairly

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anticipated that for at least a year they may not be able to furnish a transportation service equal in efficiency to the Government service. The public should be prepared for this emergency, and the carriers should adopt a new attitude toward the public which will keep them informed of existing conditions. Failing in this, the public demand may swing back to public ownership. An efficient and competent transportation service must be furnished. On the whole, competition in service produced better service than the Railroad Administration has been able to give. It remains to be seen whether the private owners can excel the Government administration in the future. The shippers of freight are convinced that the dangers of public control far exceed any disadvantages attaching to lack of uniform or consolidated operation under private management. On the other hand, they look forward to the return of competition and the control of the various systems of railraods by the respective private organizations of expert railroad managers as an immediate solution of the transportation question. The re-establishment of effective transportation systems out of the welded system of the whole country is complicated at once with hundreds of problems never before met in the history of railroads. These problems cannot be solved in a day or a month, or perhaps in years. It is during this time that the public should be patient. Some of these problems requiring time for solution concern the insufficient car supply. There should develop a new kind of railroad publicity and a new attitude of officers and employees toward the public. The public should be kept informed of the difficulties of reorganization and of the progress made and the plans for the future.

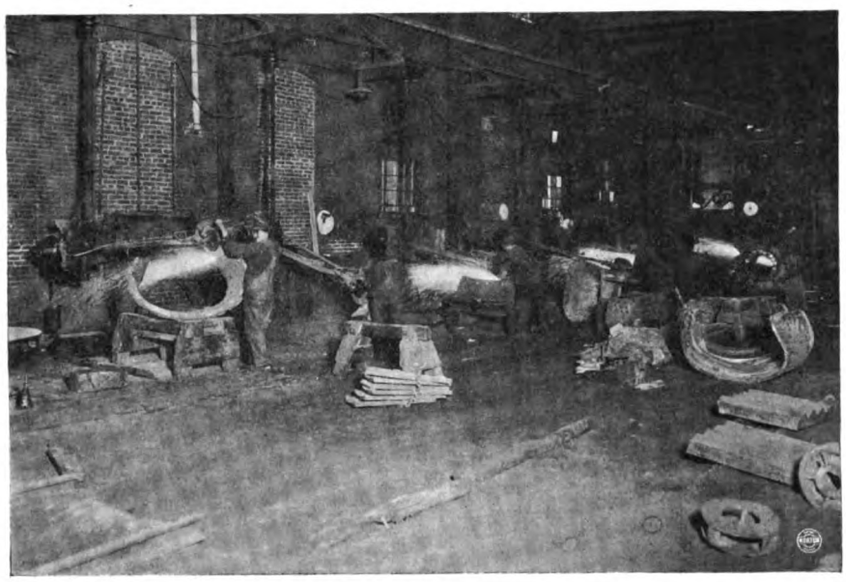

Fig. 1. Battery of Swing-Frame Grinding-Machines

The 'West Nomentum', an 8800-ton steel freighter for the U. S. Shipping Board, was launched at the yard of the **Southwestern Shipbuilding Co.** on March 21. The company has laid the keel for the last of the vessels to be constructed by it under contract with the Shipping Board. It also has commenced work on the first of several 12,000-ton steel tank-steamers to be built for the Union Oil Company.

GRINDING MANGANESE STEEL*

By R. M. Johnson

Grinding manganese-steel, either snagging or semi-precision, is a severe operation. Chisels cannot be used for removing the heavy fins and burrs from the rough castings. They must be broken off with sledge-hammers before annealing or cut with an oxy-hydrogen or oxy-acetylene torch. Whichever method is used, the castings are rough and jagged when they come to the cleaning-room.

Fig. 1 shows an excellent installation of swing-frame grinding-machines. The reader's attention is called especially to the excellent construction of the machines, which are rigid, have plenty of power, and are suspended from one point, giving universal movement. The work shown is the rough snagging of gold-dredge buckets, nose-pieces for these buckets, and rock-crusher parts. The wheel used is a 20 by 3½ by 2-in., 6616, grade Q. Fig. 2 shows a close-up view of one of the swing-frame machines snagging a gold-dredge bucket.

A similar arrangement can be employed for the wheels used for snagging small castings such as gears, pipe-balls, dipper-tooth points, and similar castings. Alundum wheels, 24 by 3½ by 2-in., 6616, grade Q, are used.

For such snagging operations the grinding-wheel must be free cutting. At best, considerable heat is developed when manganese-steel is ground; slow-cutting wheels increase heat and increase the possibility of breakage. Hard wheels heat and cut slowly; soft wheels are cool cutting, grind rapidly, and of course wear faster than hard wheels. Study of conditions will permit the selection of the grain and grade that gives the best results when considered from all angles.

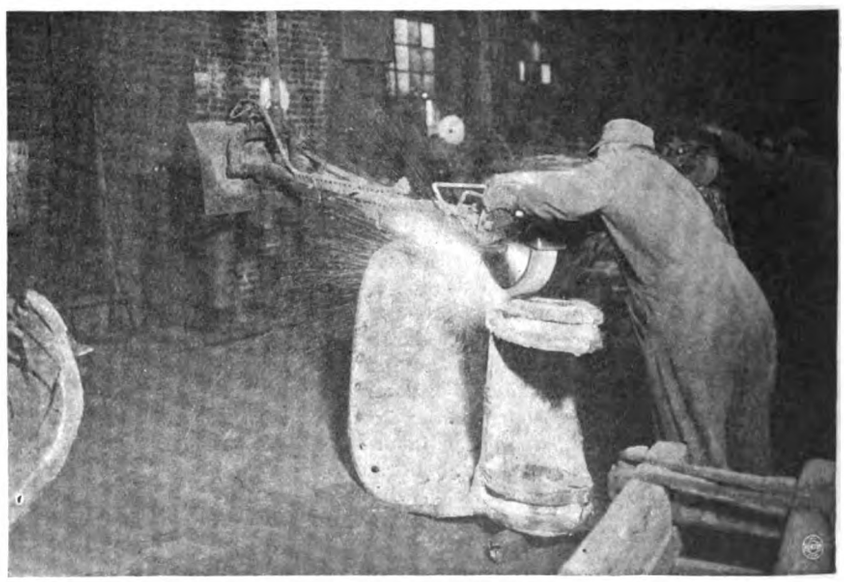

Fig. 2. Snagging a Gold-Dredge Bucket on One of the Swing-Frame Machines Shown in Fig. 1

A cylindrical-grinding machine used for finishing the periphery of crane-wheels is shown in Fig. 4. An 18 by 2 by 8-in., grain 30, grade N, alundum vitrified wheel running at about 6500 s.f.p.m. is used. The work revolves at 32 r.p.m.,

*From 'Grits and Grinds'.

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a surface-speed of 100 ft. per minute. A fillet is ground on both sides of the tread, the wheel being fed straight in. Fig. 5 shows another cylindrical operation, grinding pipe-balls. The wheel speed is 6500 s.f.p.m., work speed 200 s.f.p.m., feed 0.010 inch, table traverse 108 in. per minute. The part ground is 11 in. diam. by 6 in. long. This operation is a severe test for a grinding-wheel; it must cut rapidly or the wheel-wear is excessive. A 20 by 2½ by 8-in., grain 6630, grade Q, alundum vitrified wheel is used.

A special lathe which can be rigged for all kinds of work is shown in Fig. 6. The picture shows an 8 ft. 7⅛ in. diam. suction-side liner for a centrifugal pump being ground with a 14 by 2 by 1¾-in., grain 24, grade M, alundum vitrified wheel. A work-speed of 300 ft. per minute is used.

Fig. 7 is a specially designed machine for surface-grinding and is called a pit-grinding machine. It mounts four 10 by 1¾ by 1½-in., grain 24, grade M, alundum vitrified wheels. The picture shows the machine being used for grinding the ends of ball-mill plates used in a cement-grinding machine. The traverse is 144 in. per minute.

Another surface-grinding machine, a planer type, is shown in Fig. 8. It is shown surfacing crusher-segments. The wheels are 10 by 2 by 1½-in., grain 24, grade M, alundum vitrified. The table traverse is 240 in. per minute.

The manufacture of manganese-steel safes is an interesting process. The rough castings are snagged in the cleaning-room. The door-hole in the safe is ground internally on a lathe. Fig. 3 shows a special lathe used for cylindrically grinding the safe-doors, where a 12 by 1¾ by 1½-in., grain 24, grade M, alundum vitrified wheel is used. The work speed is about 20 ft. per minute. After the door and the door-hole have been ground to practically the same size,

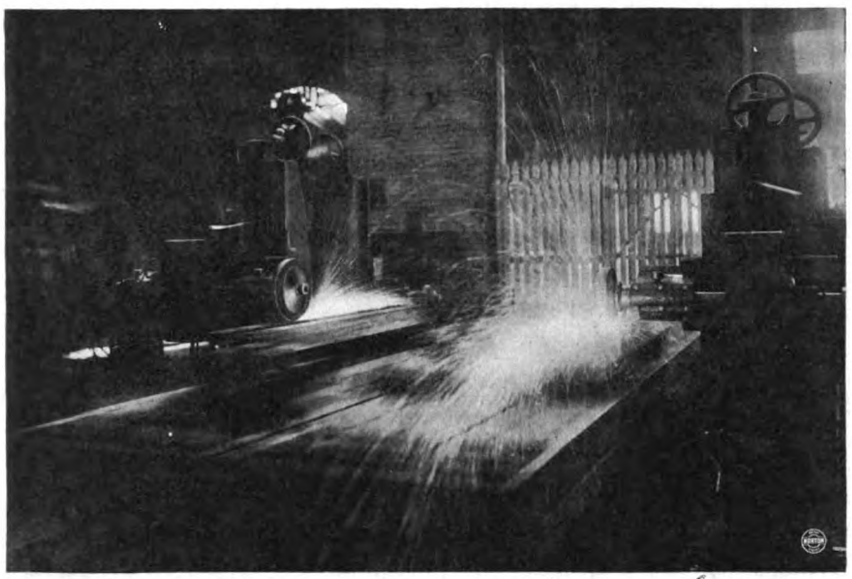

Fig. 8. Surfacing Crusher-Segments on a Planer with an Alundum Vitrified Wheel

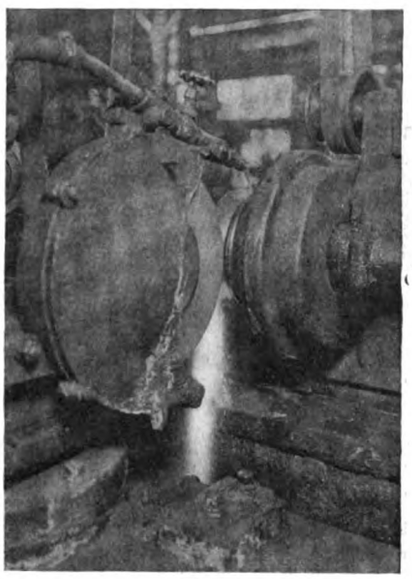

Fig. 4. Finishing the Periphery of a Crane-Wheel on a Cylindrical Grinding-machine

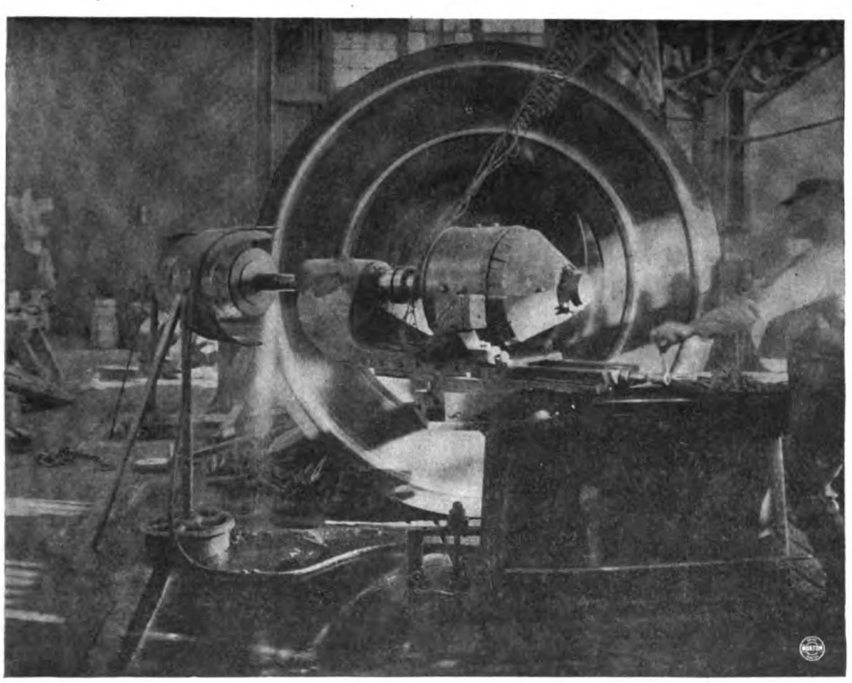

Fig. 6. Grinding a Suction-Side Liner for a Centrifugal Pump on a Special Lathe with an Alundum Vitrified Wheel

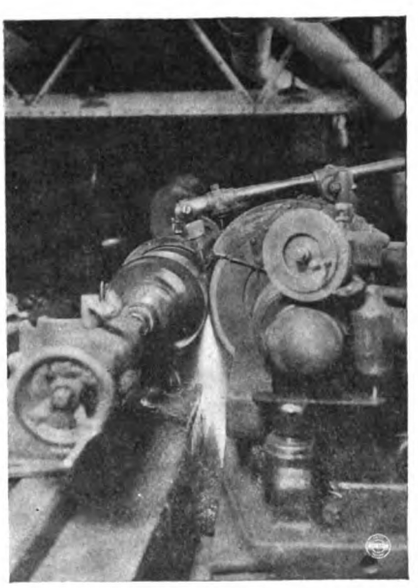

Fig. 5. Grinding Pipe-Balls with an Alundum Wheel

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abrasive grain mixed with oil is placed on the bearing surface and the door lapped until the safe is air-tight.

SHOCK-ABSORBING DEVICE FOR WHEELS AND GEARS

A device for absorbing shocks and reducing wear in wheels and gears has recently been developed and patented by J. J. Halloran, of Daly City, California. The essential feature is the placing of a series of elastic disks, cylinders, or spheres made of some elastic material between the hub and the circumference of the wheel or gear. The device, therefore, consists of three principal elements: first, an axle carrying a hub with plain or curved surfaces; second, cushion members moving on these surfaces and providing means of contact with corresponding surfaces on the third element, which is a rim or tire section carrying the tread of the wheel or the teeth of the sprocket as the case may be. As already noted, the cushion members may be of various shapes according to the class of service required, and the material may be any elastic substance from soft rubber to spring-steel. Thus the cushion members act like the spokes of a wheel except that they can move freely within a limited space, not being fixed to either the hub or the felloe. As the axle is turned, tending to rotate the outer section of the wheel or gear through the medium of the cushion members, the lag or play caused by the rolling of one part upon another gives a spring effect. This gives greater power of absorbing shock, correcting alignment, and reducing wear as compared with the rigid wheel. The cushion members also tend to reduce the strain coming from the starting torque.

The illustration shows a standard motorcycle sprocket that originally had in its web, which is 5/32 in. thick, eight round holes spaced equally around a 5⅛ in. circle. Part of the web was first removed around the entire circumference, leaving a hub and an outer ring or rim. In both these parts were concave recesses left by the holes in the original web. Rawhide disks of the same thickness as the web and with a diameter equal to the original web-holes were then fitted into corresponding recesses in the hub and outer ring, and were held in place by cover-plates, a pair of which were attached by machine-screws to each part of the sprocket. These cover-plates extend on each side of the disks so that when the hub is in the normal central position, the adjacent edges of the plates are $\frac{5}{16}$ in. apart. Where the cushion members are made spherical, cover-plates are not required because the walls of the grooves take the side thrust.

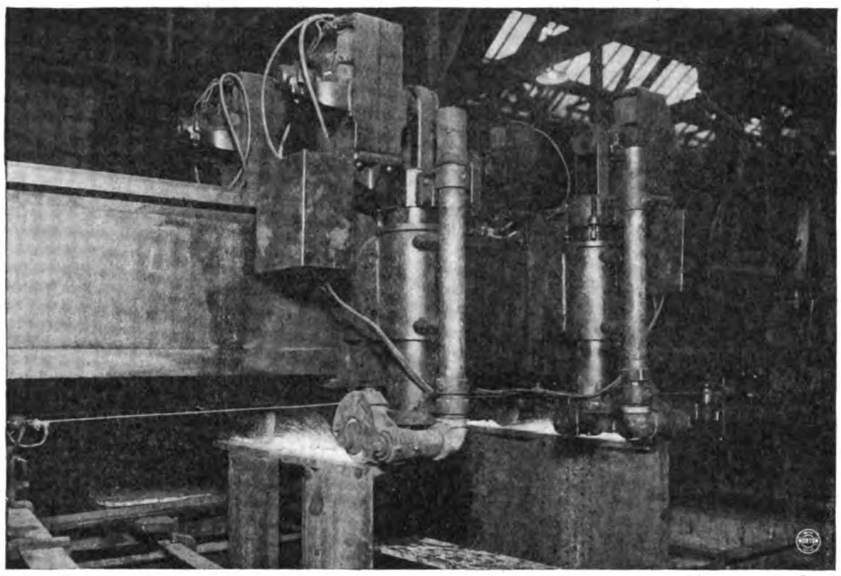


Fig. 7. A Pit-Grinding Machine Mounting Four Alundum Wheels Grinding the Ends of Ball-Mill Plates Used in a Cement-Grinding Machine

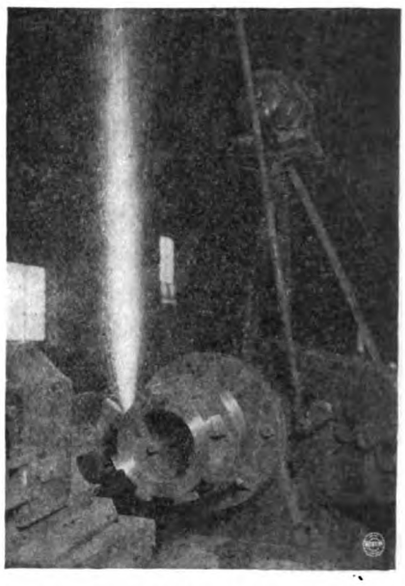
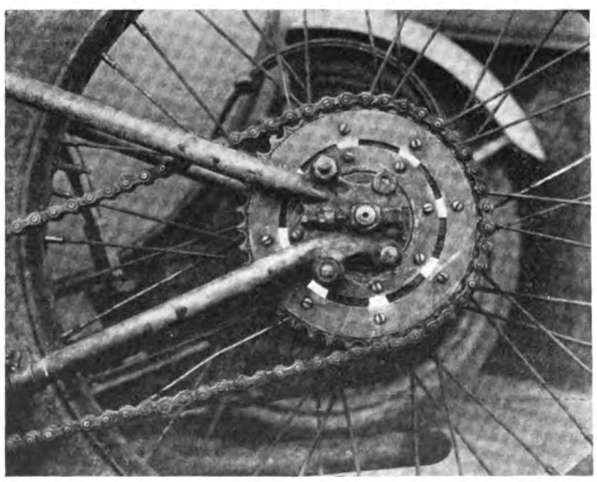


Fig. 3. Special Lathe for Grinding Safe-Doors



Device Applied to Motorcycle Drive

While the first experimental work was done with a motorcycle, it is believed that the device would be of even greater advantage for ordinary steel-tired wheels for railroad-cars. Another important field is for large gear-drives, where by compensating for inaccuracy of alignment, the wear on the gear-teeth would be reduced.

THE HUGHSON-BACON CYLINDER RE-BORING MACHINE

Like all machine parts, the inside of the cylinder of an internal-combustion engine is subject to wear as a result of service. As soon as this wear reaches an appreciable amount, lost compression and its attendant evils appear. When this happens a cylinder re-grinding job becomes necessary. The proper equipment for grinding cylinders calls for an outlay that the average owner of a machine-shop or garage does not feel justified in incurring, so that, particularly in the country districts, the facilities for grinding cylinders are inadequate to give the owners of automobiles, trucks, and tractors the service they need. The result is that most owners, faced with the alternative of dismantling their machines and waiting several days until the engines can be sent to a shop in one of the large cities and returned, run their machines at

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low efficiency for long periods rather than suffer the delay of dismantling their machines and waiting for the engines to be sent to a shop in one of the large cities for grinding. Even when the facilities are available several hours are required to remove and replace the cylinder-block. A number of attempts have been made to develop an inexpensive machine

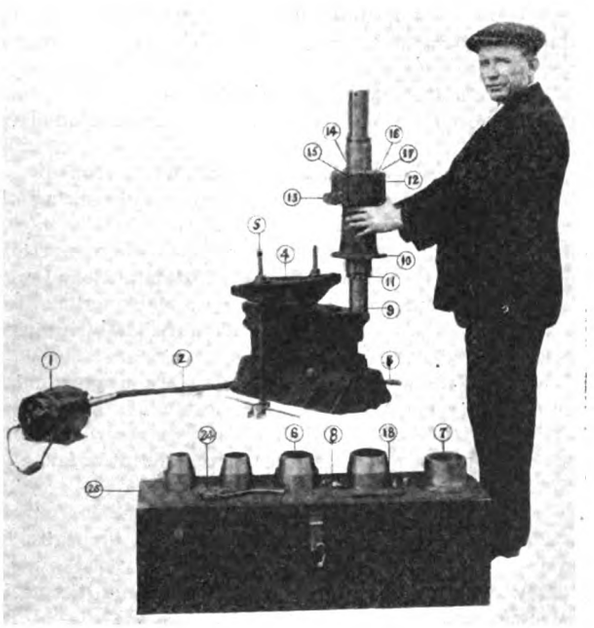

Fig. 1. The Hughson-Bacon Machine

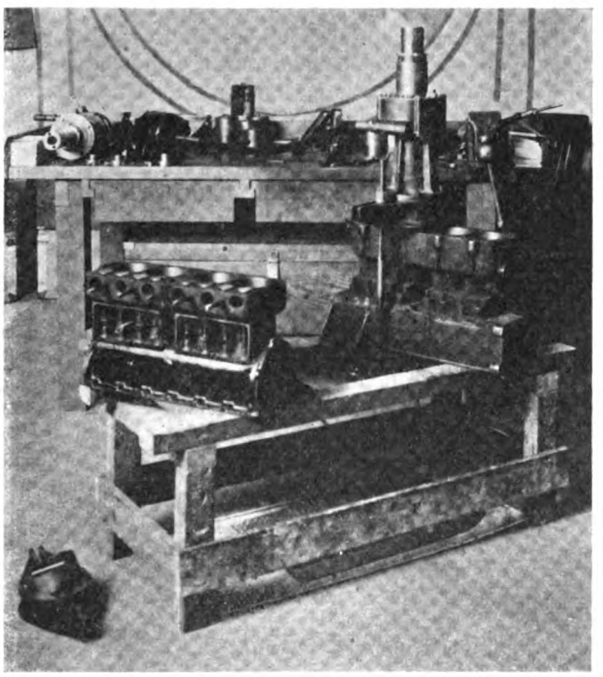

Fig. 2. Machine in Position for Re-boring Cylinder

for re-boring cylinders and one that would not require removal of the cylinder-block, but so far such outfits as were developed did not give sufficient accuracy.

After several years of study and experiment, the Hughson-Bacon Co. of Oakland has perfected a light and relatively inexpensive machine for doing this work and one that will bore a hole with a maximum error of 0.0005 in., which is sufficiently close for all practical purposes. Fig. 1 shows the machine and the tool-box in which it is packed for shipment, while Fig. 2 shows the outfit clamped in place on an engine and ready to start work.

In Fig. 1, (1) is the $\frac{1}{8}$-hp. induction-motor used to drive the outfit; (2) is a flexible drive-shaft; (3) is the worm-drive; (4) is the machine-base; (5) is one of the two base-clamps that hold the engine in place; (6) shows four tapered cones of different sizes to handle cylinders from $2\frac{1}{2}$ to $5\frac{7}{16}$ in.; these cones permit quick centring of the cylinders; (9) is the boring-bar, which is $2\frac{1}{2}$ by 32 in.; (10) is the bottom housing; (11) shows bronze take-up bushings; (12) and (14) show the middle and the upper housing, respectively; (13) is the worm-housing, which has a ball thrust-bearing; (25) is the tool-box.

The machine is equipped with a variable feed that gives

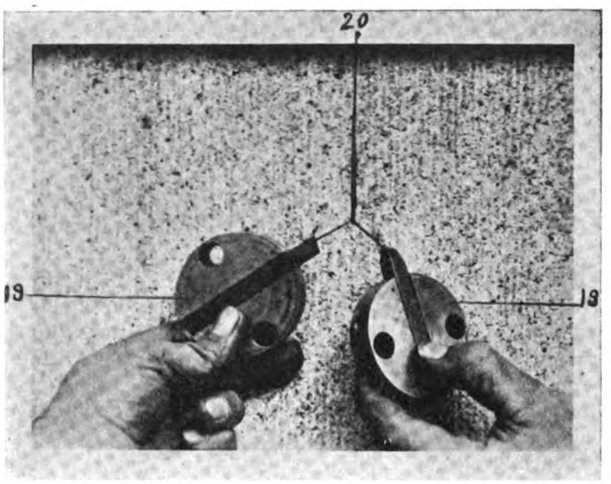

Fig. 3. Cutting-Heads and Tools for Roughing and Finishing Cuts

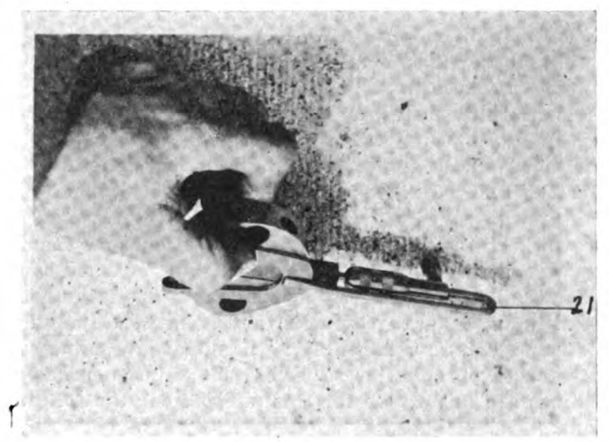

Fig. 4. Special Three-Point Micrometer

feeds ranging from 14 to 120 cuts per inch. Motors can be supplied for any ordinary current. Cylinders for any automobile, truck, or tractor ranging in size from $2\frac{1}{2}$ to $5\frac{7}{16}$ in. diam. inclusive can be handled.

Of open-head engines, 70% can be re-bored without removing the block from the car, thus saving several hours' work. On detachable-head motors the following method is used: Clear the top-face of the block and remove the lower half of the crank-case, take out pistons and cover crank-shaft bearings. The engine is then ready for setting the re-boring machine. In care where the dash extends over the last hole in the cylinder-block, it is usually easier to loosen the body-bolts and slip the body back so that the machine can set upright over the last hole in the cylinder-block,

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rather than to take out the block. The maximum time for re-boring per cylinder is 30 minutes, taking two roughing cuts and one finishing cut. Fig. 3 shows the two detachable cutting-heads and the cutting tools for both the roughing and the finishing cuts. Fig. 4 shows a special three-point micrometer for setting the cutting-tools. A setting of the micrometer-head in the first hole corresponds to a cylinder diameter of exactly 2½ in., in the second hole, a diameter of 3½ in., and in the third hole, a diameter of 4½ in. For convenience in setting the micrometer and to eliminate the possibility of errors, the company has prepared a chart showing micrometer-settings in thousandths of an inch for all cylinder diameters from 2½ to 5½ in. varying by sixty-fourths. Thus, for a desired cylinder-diameter of 2 45/64 in., the micrometer-head is set in the first hole and the micrometer itself is set at 0.101 in. Similarly for a diameter of 4¾ in., the head is in the third holes and the setting is at 0.125 in. All this is read direct on the chart by the mechanic without computation.

To ensure the cutting-tools' being always in first-class condition, the company maintains a service on dressing the tools without charge. It also furnished oversize pistons for fitting to the re-bored cylinders.

COMMERCIAL DIAMONDS FOR TRUING GRINDING-WHEELS*

By W. R. Moore

The problem of selecting the commercial diamond best suited for truing modern grinding-wheels is one of great importance to all concerns where any form of precision or tool-room grinding is practised.

The two principal sources from which diamonds are obtained are:

1. South Africa
   (a) Brown bort
   (b) Gray bort
   (c) Ballas
2. Brazil
   (a) Brazilian bort
   (b) Brazilian ballas
   (c) Carbon (black diamonds)

African brown bort, gray bort, and ballas stones are probably the most widely used. Approximately 85% of the factories use these stones, which should indicate that they render the best average service and are most economical to use.

Brown bort and grey bort are somewhat cheaper than the ballas stones and give excellent service, but for some classes of work the ballas stones are reported as being far superior.

The opinion generally prevails that every bort diamond is imperfect. This is misleading. Diamonds are mined primarily for the production of gems, but a large number of the stones are unsuitable for this purpose for the following reasons:

1. Some diamonds have cross-grain or ballas formations and are therefore too hard to cut.

2. Some diamonds contain a number of black carbon spots, thus making imperfections in the gem.

3. Diamonds of a brown, gray, black, or cloudy white appearance are of little value for gems.

Diamonds of the above classifications are sorted from those suited for gems and are used for mechanical purposes. The finer grades are recommended for truing grinding-wheels.

The color of diamonds runs from pure white through various shades of grayish leaden-white, blue, green, yellow, and brown to black. The gray, black, or white stones are generally harder than the various shades of brown. This, however, does not mean that such stones because of their hardness alone are superior to the brown stones, which are softer but not so brittle. The user should not be misled by the superficial examination of an apparently brown stone, for under the magnifying-glass or microscope the body of the stone may show clear crystalline strusture and the color may merely be on the surface.

The gray and white bort and the black ballas stones are considerably harder than the brown stones, but their hardness also makes them more brittle. This quality is important and for inexperienced operators we would recommend the best quality brown bort stones for the following reasons:

1. They are sufficiently hard to withstand reasonable wear.

2. They are not so expensive as the black diamonds (carbons).

3. They are not so brittle as gray and white stones.

4. They will stand more abuse without breaking than any other class of bort diamonds.

For experienced operators in factories, where particular attention is paid to the proper use of diamonds and where service records of each stone are kept, black ballas stones are recommended for crank-shaft and cam-shaft grinding for the following reasons:

1. These stones are hard and for severe usage on large wheels they give exceptionally good service.

2. They are not as expensive as black (carbon) diamonds.

3. They are obtained in shapes that present a large surface to the wheel.

For general precision grinding where care is exercised and accurate service records are kept, gray or white bort stones are preferred for the following reasons:

1. They are obtainable in shapes that lend themselves to secure setting.

2. They will give a large number of dressings before being reset.

3. They will wear considerably longer than brown bort stones.

4. For larger users, it is not necessary to carry such a big stock on hand to provide for stones being reset as with brown bort stones.

The shape of the diamond is important, an octahedron or eight-sided crystal being most desirable and economical, provided proper attention is given to the resetting of the diamond. However, the shape of the diamond should not be subordinated to the quality, as there are many odd-shaped pointed stones of a knotty nature that give excellent service.

The main factors that determine the size or weight of stones used for truing porposes are:

1. Diameter of wheel.
2. Thickness of wheel.
3. Hardness or grade of wheel.

The following table should be some assistance in making selections of diamonds:

Norton Wheels, Grade M and Softer

Diameter	Face	Size of diamond
Up to 6 in.	1 in.	1 carat
6 to 12 in.	1 in.	1 carat
12 to 18 in.	1 to 1½ in.	1¼ to 1½ carats
18 to 24 in.	2 to 4 in.	2 to 4 carats
Diameter	Face	Size of diamond
Up to 12 in.	1 in.	1 carat
12 to 18 in.	1 to 1½ in.	1½ to 2 carats
18 to 24 in.	2 to 4 in.	3 to 5 carats

Many different opinions are expressed with regard to the best methods to employ in setting diamonds, and too much care cannot be given this important question.

The 'peening mount' may give satisfactory results if performed by a careful and skilled mechanic. In 'peening' a diamond, however, there is great danre of damaging the stone, and for that reason this method is not advised.

The 'brazed-in mount' is one of the older methods of

*Abstract from 'Grits and Grinds'.

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mounting diamonds. It is satisfactory only when extreme care is used in the brazing process. Even then, when a brazed mount is opened, air-holes are often found around the back or sides of the stone, which render it liable to fracture by shocks. A brazed mount really does not take a firm grip on the stone. It merely prevents it from falling out.

The cast-steel mount overcomes many of the objections to the brazed-in mount and is a step in the right direction. The molten metal flows around the irregular surfaces of the diamond, and on cooling contracts and grips the stone firmly. Some manufacturers are of the opinion that the high temperature of this molten metal is likely to injure the diamonds by carbonizing the outside surface, which tends to soften it or make the stone more brittle. Small carbon spots are also apt to become gaseous under the extreme heat, the expansion thus tending to weaken the diamond across the line of cleavage.

As it is generally recognized that the casting of some type of molten metal around the diamond makes the best mount, it therefore remains only to determine a metal that has a low melting-point, and which at the same time has a high coefficient of expansion in heating and contraction in cooling. Several metals fulfil these conditions. A good metal for the purpose is silver-solder.

The following suggestions should help to obtain more efficient as well as more economical results in using diamonds:

1. Take light cuts with the diamond.
2. As the diamond wears, turn the nib in the shoulder to assure uniform wear.
3. When the stone wears down to the metal-setting, be sure to reset the stone so as to expose a new cutting surface.
4. When the diamond is worn down to a small size, reset it in a holder and mark for tool-room use.
5. Instruct operators to be careful about giving the diamond any hard knocks. The stones are hard and for that reason brittle.
6. Be careful not to jam the diamond into the wheel.
7. Never use a diamond dry except perhaps on small wheels for internal grinding or on tool and cutter wheels.
8. On large wheels for cylindrical or surface grinding, use a copious stream of water and direct it on the diamond at its point of contact wtih the wheel.
9. Keep records of the actual service obtained from the diamond, listing such points as number of stone, original weight of stone, weight at each resetting, class of grinding for which it is employed, number of truings obtained from each setting, and total number of truings before the diamond is worn out.

Book Reviews

Forge Practice and Heat-Treatment of Steel. By John Lord Bacon. Third edition. Pp. 407. Ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $1.75.

The author of this book was for some time instructor in forge practice at the Lewis Institute at Chicago, and the text is based on notes prepared for courses given there. In the third edition the subjects of hardening, tempering, and annealing are treated at considerably greater length than in the previous editions. The first chapter is devoted to a general description of the blacksmith's forge and tools. Welding in the forge is next discussed, and then the making of all kinds of hand forgings, including the calculation of stock, and the methods of actually doing the work. Steam-hammer work is then considered, also the use of dies to produce duplicate parts. The remainder of the book is mainly devoted to tempering, hardening, annealing, and casehardening, and discusses both the equipment used and the methods of doing the work. The treatment is non-technical and practical throughout, theoretical discussion being eliminated as far as possible. It will be of value not only to the apprentice and mechanic but also to the engineer who either uses or has charge of the manufacture of forgings.

The Lathe, Bench-Work, and Work at the Forge. By Henry D. Burghardt. Pp. 318. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.

The author is instructor in machine work in a high school in Jersey City, and the book is addressed primarily to the boy or man learning the trade. Thus the first chapter is devoted to a general discussion of the machinist's trade. Then the general features of the lathe are considered, followed by a discussion of cutting tools and speeds and of gauges and micrometers. The various operations of centring, facing, chucking, and turning are then considered, as well as the cutting of tapers and of screw-threads. Three chapters are then devoted to the various aspects or bench-work. The chapter on forge-work is brief and is concerned entirely with babbitting, brazing, soldering, and the tempering of tools. An appendix contains a number of useful tables. The book is an excellent text and reference book for the apprentice machinist.

Electric Furnaces in the Iron and Steel Industry. By W. Rodenhauser, J. Schoenawa, and C. H. Vom Baur. Third edition. Pp. 444. Ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $4.50.

The rapid progress being made in the electric-furnace industry is indicated by the fact that a third edition of this book has become necessary in less than three years from the date of the appearance of the second edition. The principal changes and additions relate to the field of practice, such as descriptions of the newer types of furnaces and the inclusion of considerable new cost and other operating data. The new edition follows the same general lines as the preceding ones. After a brief historical chapter tracing the early developments in the industry, the fundamental phenomena of electricity affecting the electric furnace are discussed. Arc-furnaces in general are then considered, after which are several chapters discussing, in turn, the Stassano, Heroult, Girod, and Rennerfelt furnaces. Similarly, a chapter is given to the induction-furnace, followed by chapters relating to the Kjellin and the Rochling-Rodenhauser furnaces. Then comes a chapter on electric-shaft furnaces, and one discussing various other arc and induction furnaces, including the Chapelet, Keller, Nathasius, Gin, Schneider-Creusot, Gronwall, Lindblad & Stalhane, Greaves-Etchells, Snyder, Greene, Hiorth, Moore, Booth-Hall, Vom Baur, and Ludlum types. This completes Part I. Part II begins by considering the materials of furnace construction, principally refractory linings. Then follows a general discussion of costs of operation, including considerable specific data on actual operation. The remainder of the book is devoted to the electro-metallurgy of iron and steel and treats, in turn, the electric smelting of iron ores and the use of the electric furnace for melting, for the refining of pig-iron, and for the production of ordinary and special-quality steel. This edition, like the preceding ones, ranks among the best treatises on the subject, and it will be needed by everyone engaged in the industry.

L. J. Barton, formerly chemist at the Oakland plant of the American Manganese Steel Co., has gone to Sacramento to take charge of the operation of the six-ton Heroult electric furnace recently installed in the steel foundry at the Southern Pacific Co. shops.

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Trade Notes

The plant of the **Ford Motor Co.** at Los Angeles is to be enlarged.

The Sperry Flour Co. is building a $150,000 grain-elevator at Stockton.

The Magnus Co., Inc., has purchased the Acme Brass Foundry, at Los Angeles.

The Richardson-Chase Co., of San Jose, will construct a $250,000 cannery at Stockton.

J. F. Garrett is building a one-story foundry at 30th and Poplar streets at a cost of $30,000.

V. C. Worden has been appointed chief engineer for the **Master Carburetor Co.** of Los Angeles.

The Johnson Electric Washer Co., Emeryville, will build a one-story brick factory to cost about $40,000.

The Silverton Blowpipe Co., of Silverton, Oregon, is advertising for bids for the construction of a foundry.

B. T. Hughes and C. R. Crawford have formed the **Guarantee Welding Co.** at 725 East Lafayette street, Stockton.

The Pacific Fruit Express will spend $2,000,000 on enlargement of its various plants during the coming season.

The R. Hickmott Canning Co., of San Francisco, has purchased five acres at Antioch and will erect a modern cannery.

The Lowell Wrench Co., of Worcester, Massachusetts, has issued a new catalogue describing its reversible ratchet-wrenches.

The Union Construction Co. has been awarded the contract for five coast-guard cutters. The total estimated cost is $3,430,000.

Contracts for furnishing valves for the outlet system of the Hetch Hetchy dam have been awarded to **William Cramp & Sons** for $173,000.

John A. Griffin has been appointed city engineer of Los Angeles. He was formerly structural engineer for the **Llewellyn Iron Works.**

The National Radio Co. will construct a factory for making wireless equipment on 20th near Folsom street. The estimated cost is $65,000.

Frank Johnson, of San Francisco, has purchased the old **Marysville Woolen Mills** and will remodel the building for an automobile-repair shop.

The Lathe Tool Works of San Francisco has been incorporated with a capital of $50,000 by F. A. Lathe, Thomas M. Paterscn, and Leo Susman.

The Taylor-Mayhew Pump Co. is erecting a new plant in Oakland for manufacturing oscillating pumps. F. J. Mayhew is president of the company.

Vic Hayes has purchased the **Boston Machine Shop** at Oroville, California, and will remodel it for a repair and rebuilding shop for automobiles.

The United States Manufacturing Co. has decided to build a new plant at Boise, Idaho, to manufacture sheet-metal products, culvert-pipes, and silos.

The Columbia Fruit Products Co., of Hanford, Washington, will erect a cold-storage plant and enlarge its present plant for canning and preserving fruits.

The Norway Pacific Shipbuilding Co., of Everett, Washington, has been awarded a contract for building five 12,000-ton tank-steamers for a Norwegian syndicate.

The Orpheum Theatres Co. will construct a 12-story Class A office and theatre-building at Eighth and Hill streets, Los Angeles. The estimated cost is $2,500,000.

The new plant of the **Moreland Motor Truck Co.** at Burbank, near Los Angeles, is practically complete, and the company's forces will be moved there during April.

The Kroyer Manufacturing Co. has opened offices at Market and Aurora streets, Stockton, pending the construction of its plant for manufacturing tractors in the north-eastern part of the city.

The Schaw-Batcher shipyard at South San Francisco is to be closed and the work now under contract there is to be completed at the yard of the Southwestern Shipbuilding Co. at Los Angeles.

The Olympia Foundry Co., of Olympia, Washington, has been incorporated by W. L. Phillips, William Allard, and others. An iron-foundry will be built immediately, and later a brass-foundry.

The Metallic Boat Co., of Portland, has been incorporated by L. A. Jones, Joseph Page, and W. Harris. The company will build small all-steel boats for fishing, cannery tenders, and similar uses.

F. L. Feisthamel, formerly California manager for the **Lucey Manufacturing Corporation,** has resigned to become manager for the **Grant Tool Co.** He has been succeeded by **Edward Everett.**

Additional machinery has been ordered for the factories of the **American Photo Player Co.,** at Berkeley and Van Nuys. Both factories will be considerably enlarged before the end of the summer.

The Weber Showcase & Fixture Co., of Los Angeles, will spend $100,000 on enlarging its plant and purchasing additional machinery for the manufacture of soda-fountains, showcases, and furniture.

The Bastian Combination Water-Heater Co. is building a plant for making water-heaters and range-boilers at 1610 Hooper avenue, Los Angeles. The company's authorized capitalization is $500,000.

Charles Austin Hirschberg, Inc., advertising counselors, specializing in the technical field, announce that they are now situated in their permanent home in the Sun building, at 150 Nassau St., New York.

The Motor Products Corporation, of Los Angeles, has been incorporated by C. C. Bogardus, M. F. O'Dea, and J. R. Morton with a capital of $100,000, for the purpose of manufacturing automobile motors and parts.

O. H. Johnson has been appointed special representative for the Intermountain region of the **Taylor-Wharton Iron & Steel Co.,** of High Bridge, New Jersey. Mr. Johnson will have his office in the Denham building, at Denver.

The Western Metal Products Co., Alameda, has been incorporated with a capital of $50,000 by Ferdinand Kretz, Henry W. Schnelby, and John F. Hostrawser. The company will manufacture and distribute bronze and aluminum products.

A site has been purchased at West Sacramento for the packing-plant that is to be erected by the **Virden Packing Co.** during the coming season. The estimated cost is $1,500,000. Buildings will be of steel and reinforced concrete.

The Ames Shipbuilding & Drydock Co. has delivered the 'West Jappa' to the U. S. Shipping Board. This is the twenty-fifth and last ship under the company's contract with the Board. At present the company's yard is shut-down entirely.

The Armstrong-Watson Co., of Los Angeles, has been incorporated with a capital of $200,000 by Henry I. Armstrong of Long Beach, and Alexander Watson and Andrew Laidlaw of Los Angeles. The company will manufacture pumps and pumping machinery.

The National Tool Co., of Cleveland, has issued catalogue E describing the milling cutters and other small tools manufactured by the company. The catalogue also contains a number of useful tables of cutting-speeds, screw-threads, and similar data.

Anderson-Barngrover Co., of San Jose, announces that a series of educational talks, with music, will be given once a week during the noon hour for the benefit of its employees. The first of these was given March 3 by Dr. Frank Patterson on 'Wartime Health Lessons'.

John L. Byrnes, of Philadelphia, and several Los Angeles men, whose names have been withheld, are promoting a

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company to build a factory for manufacturing lathes and other machine-tools at Torrance near Los Angeles. The estimated cost of the plant is $150,000.

Commander James Reed, senior assistant naval constructor in the hull division at the Mare Island Navy Yard, has forwarded his resignation to the Navy Department with the request that immediate action be taken. He is intending to enter private business at Los Angeles.

The Todd Drydock & Construction Co. has launched the steamer 'Otho', the nineteenth vessel to be constructed by the company under its contract with the U. S. Shipping Board. The company has four more vessels under construction for the Board and two on private account.

The Byron Jackson Iron Works announces that it has purchased a site in Los Angeles and will erect a branch factory at a cost of about $100,000. The building will be 50 by 100 ft. and will contain about $25,000 worth of machinery. It will be ready for operation about August 1.

Herberts Machinery & Supply Co. is erecting a two-story building at First and Minna streets, which will have about 14,000 sq. ft. of floor-space. The building will be modern in every respect, and will have large show-windows and a display-floor. The estimated cost is $100,000.

The Manufacturing Equipment & Engineering Co., of Boston, has issued several small bulletins describing its line of all-metal sanitary and fireproof equipment, including washbowls, clothes-lockers, plumbing fixtures, stools, chairs, racks, drinking-fountains, and miscellanoeus equipment.

L. E. Sowers and associates will build a plant at Winnemucca, Nevada, for the manufacture of sodium tungstate, tungstic acid, tungsten powder, caustic soda, calcium chloride, sodium compounds, and various acids used in refining metals. About $35,000 will be expended on the building.

George A. Armes, president of the **Moore Shipbuilding Co.,** has been elected to the board of directors of the **California Manufacturers' Association,** succeeding **O. H. Fischer.** Mr. Armes is also a member of the Advisory Committee of the California Metal Trades Association and is a director of the Oakland Chamber of Commerce.

The Ferro Products Co. will build a plant at Ferro on Monterey bay to manufacture paint and iron pigment from the black sand found there. A permit has been issued to the company to sell 1000 shares of stock at $100 per share. Of this amount $50,000 will be spent in the erection of a plant and the remainder for machinery.

R. N. Buell, one of the proprietors of the Buell-Santmyer process for burning powdered coal, described in 'Metal Trades' for January 1919, was in San Francisco last month on his way to Australia, where he will have charge of the construction of a power-plant burning powdered coal to be built at Abbotsford, a suburb of Victoria.

H. G. Knapp & Son, plow manufacturers of San Jose, have recently completed a one-story brick building at Fourth and Margaret streets, and have moved most of their shop there. The old shop on South First street is being devoted mainly to side-hill plows. Plans are now being considered for the construction of a foundry during the coming summer.

The new steel foundry at the **Southern Pacific Co.** shops at Sacramento will begin operations during April. The building is equipped with a six-ton Heroult furnace and has a floor-area of 12,000 sq. ft. A large number of steel castings for the railroad, which used to be ordered from Eastern makers, will in the future be made at the Sacramento shops.

The Palmolive Co., of Milwaukee, whose plant at Portland was recently destroyed by fire, will not re-build at that place but instead will construct a factory at Oakland. The estimated cost is $500,000. Plans are also being considered at Portland for the formation of a locally financed company to construct a copra-pressing and refining plant in order that Portland shall not lose this industry entirely. C. A. Edwards and Walter Kendall are interested in the project.

The Moore Shipbuilding Co. has purchased from the **Skinner & Eddy Shipbuilding Corporation** the 12,000-ton floating drydock at the latter company's yard at Seattle. The dock is in five sections, and each section will be towed separately to the Moore yard on the Oakland estuary. The first section will be started from Seattle about April 15.

The Pelton Water Wheel Co. has announced the appointment of W. D. Ward as manager of its Atlantic Department at 90 West street, New York. Mr. Ward has been associated with the company for more than 25 years, having been the ranking sales-engineer in the home office at San Francisco previous to his assumption of the post in New York.

The name of the **Commercial Auto Car Co.,** which has been building automobile busses at the old plant of the Liberty Iron Works of Sacramento, has been changed to the **Pacific Car Building Co.** The company will construct a $200,000 plant on the Twelfth Street road and will engage in the manufacture of railway and street cars as well as automobile busses.

The Drake Lock-Nut Co. is smoothing out the way for trade relations with the foreign buyer. Geo. F. Drake, vice-president and general manager of the company, has worked out a plan enabling him to quote c.i.f to any large seaport in the world. A buyer in Johannesburg, Buenos Aires, or Singapore may now know exactly what Drake merchandise will cost him landed at his seaport.

The Greenfield Tap & Die Corporation, of Greenfield, Massachusetts, has issued catalogue No. 43 on 'Gages'. Besides describing the company's gauges and related equipment, the catalogue contains a large amount of useful technical information regarding gauging, tolerances, standard threads, etc. There are also a number of mathematical tables.

Ray T. Middleton has resigned as general sales-manager for the Standard Steel Castings Co. of Cleveland to become vice-president and director of sales and advertising for the **Kelly Metals Co.** of Chicago, Detroit, and Los Angeles. His headquarters will be at Chicago, where the Kelly Metals Co. will, at an early date, establish its principal production plant. The company will continue its present plants in Detroit and Los Angeles and later establish a third branch plant, at a point to be selected in the East.

Art Ryan and Art Wellington recently opened the **Farmers' Job Shop** on West Julian street, San Jose. As the name implies, they are making a specialty of repairing agricultural implements, and are equipped for all kinds of machine work and welding. At the present time they keep two 'outside' gangs going, mainly on lowering pumps, which the dry season and the lowering water-level has made necessary. They are also prepared to handle repairs of canning and packing machinery during the coming season.

The Whiting Foundry Equipment Co., of Harvey, Illinois, has issued bulletins No. 151 and 152. Bulletin No. 151 describes the various cranes manufactured by the company and gives a number of photographs on typical installations. Bulletin No. 152 contains a list of several thousand users of Whiting cupolas, both in the United States and foreign countries. The standard sizes of the Whiting cupolas range from the No. 0, which has a shell-diameter of 27 in., to the No. 12, which has a shell-diameter of 108 inches. These bulletins may be obtained free on request to the company.

An insurance policy for the sum of $500 will be given entirely without cost to every employee of the **Westinghouse Electric & Manufacturing Co.** who has been in the service of the company for a period of six months or more. In addition, the employees, after April 1, may increase the value of their policies to amounts varying from $1000 to $2000, depending upon their length of service and continuity of savings. All employees who have been in the company's service for six months or longer and who deposit a sum each pay-day in the Employees' Savings Fund, equal to 2% or

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more of their earnings, will not only receive 4½% interest compounded semi-annually on such deposits, but in addition will automatically have their insurance increased to amounts up to $2000, depending on the length of time they have been with the company. After five years deposits may be withdrawn without affecting the value of an employee's insurance.

The National Axle Corporation has awarded a contract for the construction of the first unit of its plant for manufacturing motor-truck axles, on its tract of 12 acres recently acquired on the outskirts of San Jose. The corporation also expects soon to construct a malleable-iron foundry at this site. A specialty will be made of axles for worm-drive trucks. Pending the completion of the San Jose factory, the corporation has arranged to commence manufacturing at the plant of the Goldie Machine Co. at Sunnyvale and to maintain offices in the Rialto Bdg., San Francisco. The officers of the company are: J. G. Travares, president; S. C. Kyle, vice-president and general manager; N. Elliott, purchasing agent; A. H. McCleary, metallurgist; and J. L. Armstrong, superintendent.

The Denver Fire Clay Co. operates its own fire-clay mines near Denver, and through every process of grinding, blending, molding, seasoning, and burning, the work is in the hands of experienced workmen and under the supervision of experts. All raw materials are first subjected to extracting chemical analysis and physical tests by skilled ceramic engineers and burned at definite temperatures under pyrometer control to assure the most uniform products possible. High-grade fire clay is refractory and chemically inert; when properly mixed with suitable clays and binders it has relatively great mechanical strength. By skillful manipulation, definite textures can be obtained having various degrees of density and porosity, so as to meet the most exacting and varied requirements of the mining and metallurgical processes. A recent Bulletin from the company describes the products manufactured in interesting style.

The Baker R. & L. Co., Cleveland, Ohio, announces an expansion of its business which will allow for greater production of Baker industrial trucks and Raulang bodies. The change includes the sale of the electric passenger-business to Rauch & Lang, Inc., Chicopee, Falls, Massachusetts. The manufacturing space made available will permit tripling the industrial truck output this year and doubling the body production. E. J. Bartless, general manager, says: "We believe in an extraordinary future for the industrial truck and that present industrial conditions are going to result in mounting sales during the next few years. Our new policy will permit of necessary expansion to meet conditions as we foresee them." The Baker R. & L. Co. commenced business over sixty years ago building coaches and later has been prominently identified with the electric-vehicle industry. It built the first electric road-vehicles offered for sale on the American market.

The Bean Spray Pump Co., of San Jose, reports a record-breaking business during both January and February. In recognition of the co-operation by its employees that made these results possible, every man and woman on the payroll received a bonus of 5% of his or her regular pay. This is independent of the company's regular premium and profit-sharing system, which was described in 'Metal Trades' for November 1919. Because of these increasing activities, the regular working force has been increased to more than 400. Three shifts are being operated in the main machine-shop and two in the toolroom. About $25,000 is being spent on new foundry equipment including a Whiting cupola. An addition has been made to the foundry providing 13,000 sq. ft. of additional molding-space. A three-story fireproof concrete building is to be erected for the pattern department, one floor of which will be assigned to the shop proper and the other two to pattern-storage.

The plan for the merger of **Westinghouse, Church, Kerr & Co., Inc.,** and **Dwight P. Robinson & Co., Inc.,** recently submitted for the approval of the stockholders of these companies, has been declared operative. At a meeting of the board of directors of Westinghouse, Church, Kerr & Co., Inc., Dwight P. Robinson was elected president of that company, pending final completion of the merger and organization of the new company. Guy E. Tripp, now chairman of the board of Westinghouse, Church, Kerr & Co., Inc., retains this position pending completion of the merger. The **Westinghouse Electric & Manufacturing Co.,** is one of the largest stockholders of Westinghouse, Church, Kerr & Co., and the two companies have been closely identified for many years. To avoid what has seemed a handicap in producing business by the latter company, on account of the belief by prospective clients that if they employed it as their construction engineer, they might be expected to purchase Westinghouse electric equipment; and also to permit the Westinghouse Electric & Manufacturing Co. to withdraw from any interest in the engineering and construction business, it was deemed in the interest of both companies that the above association should be terminated. To accomplish this without embarrassment to other stockholders, and to their advantage, negotiations were commenced with Dwight P. Robinson, president of Dwight P. Robinson & Co., Inc., looking to a merger of Westinghouse, Church, Kerr & Co. with Dwight P. Robinson & Co., Inc. As a result of these negotiations a plan of merger was declared operative, under which depositing stockholders will receive for their present holdings either cash or stock in the new company. Mr. Robinson has been in the engineering and construction business for 25 years and was for some years a member of the firm of Stone & Webster. He was also president of the Stone & Webster Engineering Corporation until 1918, when he resigned and organized Dwight P. Robinson & Co., Inc., in which company the Westinghouse Electric & Manufacturing Co., Guy E. Tripp, and others became stockholders. As the engineering and construction work of the two merging companies is largely supplemental (the Robinson company being engaged primarily in power-plant construction, and Westinghouse, Church, Kerr & Co. in railroad and industrial work), the new company will retain the personnel of both organizations.

Market Review

The demand for most iron and steel products continues to be considerably greater than the supply. Most furnaces are refusing orders for pig-iron even for the third quarter. Following are the prevailing prices for foundry-iron, f.o.b. Birmingham:

1.75 to 2.25%	silicon	.....	$43.00
2.25 " 2.75%	"	.....	44.25
2.75 " 3.25%	"	.....	46.00
3.25 " 3.75%	"	.....	47.50

Coke prices are rising, the present quotation being around $9, with prospects of a further increase when the Government control of prices is removed on April 1. The local warehouse base price on steel is $5.25 per 100 lb. on carloads and $5.50 in less than carload lots. The mill base is subject to considerable fluctuation, but is in the neighborhood of $4.75.

The local price on non-ferrous metals is as follows:

Electrolytic copper	20.00
Casting copper	19.50
No. 1 red ingot brass	18.50
No. 1 yellow ingot brass	14.00
Electrolytic zinc	10.25
Pig lead	9.50

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